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Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES 1058

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For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

04 AIRCRAFT 1059

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

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Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

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B. J. Driscoll, ed. [1961] 123 p Presented at the Oslo AGARD Conf., 24–28 July 1961

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N63-17150 National Aeronautics and Space Administration, Washington, D.C.
THE NEED FOR LEARNING IN THIS SCIENTIFIC AGE AEC-NASA News Release
Harold B. Finger June 9, 1963 14 p Presented at the Portland State Coll. Commencement, Oregon
Available from NASA, Office of Scientific and Technical Information, Wash., D.C.

The development of space technology over the last two decades is summarized and the growth of our knowledge about the earth, planets, and outer space due to our exploration of space is emphasized. The need for further knowledge, for more scientists and trained technicians and for more advanced college training to enable graduates to find a place in the space program is pointed out. D.E.R.

N63-17237 European Atomic Energy Community, Brussels (Belgium)
LEGAL CONSEQUENCES OF THE USE OF TECHNOLOGICAL EQUIPMENT IN PUBLIC ADMINISTRATION (OFFENTLICH-RECHTLICHE KONSEQUENZEN DER VERWENDUNG TECHNISCHER HILFSMITTEL BEI DER STAATSTÄTIGKEIT)
Thora von Loesch Joint Nuclear Research Center, Ispra Estab. (Italy), Sci. Inform. Processing Center, Apr. 1963 28 p 41 refs In GERMAN; English summary
(EUR-194.d; CETIS-36) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86

The influence on public and legal affairs of progress in science and technology is examined, especially as far as their

mechanization is concerned. The different legal consequences for a) administration, and b) jurisdiction are discussed and also examined from the sociological view point. Author

N63-17252 National Aeronautics and Space Administration, Washington, D.C.
ADDRESS [FORECASTING TEN YEARS OF PROGRESS IN SPACE EXPLORATION]
James E. Webb June 17, 1963 14 p Presented at the Annual Meeting of the American Red Cross, Washington, D.C., June 17, 1963
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

Functions of meteorological satellites in forecasting weather conditions, such as famine, floods, and hurricanes, are discussed. Also, how a country's economy may be aided by satellite detections is described. Communication satellites, which relay radio, radio-telephone, and television communications over long distances are described. Project Mercury and Project Apollo are discussed. N.E.A.

N63-17266 Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C.
[PAPERS PRESENTED AT THE] SEVENTH MILITARY – INDUSTRY MISSILE AND SPACE RELIABILITY SYMPOSIUM, NAS, NORTH ISLAND, SAN DIEGO, CALIF., 18-21 JUNE 1962
[1962] 471 p 281 refs
(Sponsored in cooperation with NASA, Army, Navy, and Air Force)
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N63-17289 Air Force Systems Command. Electronic Systems Div., Bedford, Mass.

RELIABILITY PROGRAMS FOR "L" SYSTEMS

James R. Barton and George H. Allen *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 303–309 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

In this paper the mission of "L" systems has been described, the complexity of the equipment indicated, and the importance of these systems to our national defense efforts pointed out. Author

N63-17305 Argonne National Lab., Ill.

RADIOLOGICAL PHYSICS DIVISION SEMIANNUAL REPORT, JANUARY THROUGH JUNE 1962

J. E. Rose and L. D. Marinelli Feb. 1963 174 p 73 refs

(Contract W-31-109-eng-38)

(ANL-6646)

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27. SKELETAL RETENTION OF THE ALKALINE EARTH RADIOISOTOPES AND BONE DOSIMETRY R. E. Rowland p 140–150 10 refs
28. THE EFFECTS OF ATMOSPHERIC STABILITY AND HORIZONTAL SHEAR ON THE ACCUMULATION AND DIFFUSION OF RADON J. E. Pearson and H. Moses p 151–168 3 refs (See N63-17310 15-21)

N63-17319 Geophysics Corp. of America, Bedford, Mass.
LABORATORY AND THEORETICAL STUDIES IN THE VACUUM ULTRAVIOLET Final Report, 2 Feb. 1962 through 2 Mar. 1963
F. F. Marmo Apr. 1963 182 p refs
(NASA Contract NASw-395)
(NASA CR-50201; GCA-TR-63-12-N) OTS: $13.00 ph, $5.66 mf

Laboratory and theoretical studies in the ultraviolet covered the following phases of theoretical planetary aeronomy: NO_2 in the Martian atmosphere, atmospheric parameter determination by rocket-borne mass spectrometers, electron temperature in the ionosphere, solar flux incident to planetary atmospheres for the spectral region from 50 A to 3000 A, absorption cross sections for wavelengths less than 3000 A, and atomic polarizabilities and shielding factors; and the following phases of experimental planetary aeronomy: the absorption and photoionization coefficients of propylene and butene-1 in the vacuum ultraviolet, the duoplasmatron as a vacuum ultraviolet light source, and the dark side airglow of Venus. D.E.R.

N63-17425 Minneapolis-Honeywell Regulator Co. Military Products Group, Minn.
COMMAND AND CONTROL SYSTEMS ANALYSIS Final Report
R. C. Kiene, A. R. Butz, and L. B. Winrich Griffiss AFB, N.Y. Intelligence Lab., Dec. 1962 144 p 20 refs
(Contract AF 30(602)-2752)
(R-RD-1539-TRI; RADC-TDR-62-612)

This report presents the steps of a generalized systems-analysis procedure for command and control systems. The steps are then followed, utilizing an existing SAGE Direction Control system as a vehicle for the study. Emphasis is placed upon modeling the human organization as a whole. Author

N63-17456 Hanford Atomic Products Operation, Richland, Wash.
RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT, OCTOBER, NOVEMBER, DECEMBER, 1962 Quarterly Progress Report
M. M. Hendrickson and J. K. Green, eds. May 27, 1963 115 p 16 refs
(Contract AT(45-1)-1350)
(HW-76559) OTS: $2.50

Progress is reported for studies on basic properties of fuel materials and fabrication methods, physics, chemical processing of reactor fuels and radioactive waste, materials development, irradiation effects on materials, fuel cycle analysis and advanced concepts, instrumentations, and nondestructive testing techniques. N.E.A.

N63-17458 National Aeronautics and Space Administration, Washington, D.C.
ADDRESS [NASA'S RELATIONS WITH INDUSTRY] News Release
Walter L. Lingle, Jr. May 1, 1963 13 p Presented before the National Capitol Section of the Am. Inst. of Aeronautics and Astronautics
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The National Aeronautics and Space Administration's relation with industry is reviewed with emphasis directed to the Agency's procurement policies, how these policies are communicated to industry, and procedures for putting these policies into effect. N.E.A.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-17144 Aeronautical Research Council (Gt. Brit.)
AERODYNAMIC AND MECHANICAL TESTS OF A MODEL OF A VARIABLE MACH NUMBER NOZZLE

Z. M. Jawor London, HMSO, 1963 14 p 3 refs
(ARC-CP-629; supersedes NGTE-M-350; ARC-23270) Available from HMSO: 2s 6d

A model of a two-dimensional variable nozzle, of a type suitable for use in a free-jet engine-test facility, has been tested to determine the uniformity of flow in the Mach-number range 1.6 to 3.0. The tests were made at about full-scale Reynolds numbers, the Mach-number variations being deduced from measurements of the static pressure by wall tappings and traverses. Only the initial build was tested over the full Mach-number range, and for this the Mach-number variation in the test region lay between ±1 1/2 and ±2 percent. The effect of nozzle-block pivot position was examined at the higher Mach numbers, and it was found that the variation could be reduced to between ±1 and ±1 1/2 percent in the range 2.4 to 3.1. Author

N63-17253 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OBSERVATIONS ON THE FLOWS PAST BLUNT BODIES AT TRANSONIC SPEEDS
Philip E. Everhart and Walter F. Lindsey Washington, NASA, June 1960 75 p 5 refs
(NASA TM X-169) OTS: $7.60 ph, $2.45 mf (Declassified)

An investigation at transonic speeds has been conducted to provide fundamental information on the flows past a variety of bodies of revolution of low fineness ratios. The effects of changes in some of the shape variables, such as skirt length, skirt angle, edge radius, and face contour upon the flow were observed in schlieren photographs of the flow past the models. Data were obtained at Mach numbers from 0.60 to 1.25 and angles of attack from 0° to 12°. The results indicate that blunt bodies are subject to motions of various degrees and that those having the highest lift-curve slopes as indicated by wake angle measurements generally exhibited the most violent motions. Author

N63-17254 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC AND HYDRODYNAMIC CHARACTERISTICS OF A PROPOSED SUPERSONIC MULTIJET WATER-BASED HULL-TYPE AIRPLANE WITH A VARIABLE-INCIDENCE WING
William W. Petynia, Albin O. Pearson, and Roger H. Fournier Washington, NASA, Apr. 1960 91 p 10 refs
(NASA TM X-249) OTS: $8.60 ph, $2.93 mf (Declassified)

The aerodynamic and hydrodynamic characteristics of a supersonic multijet water-based airplane with and without modifications have been investigated. The results of tests of the stepped-hull-type configuration have indicated that the drag rise occurs near a Mach number of 0.94. At the design Mach number of 2.0, the maximum lift-drag ratio was approximately 4.0, the same as that of a hydroski version of the same basic configuration. All configurations were stable up to the design Mach number. Excess thrust was available for a takeoff in 42 seconds for a distance of 7,000 feet. With afterbody flow deflectors, the high-speed resistance was reduced by about 46 percent, a reduction which resulted in a 30-second takeoff time and 5,000-foot takeoff distance comparable with those of the hydroski version. The stability and spray during takeoff and landing were satisfactory. Author

N63-17255 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC LONGITUDINAL TRIM, STABILITY, AND CONTROL CHARACTERISTICS OF A DELTA-WING CONFIGURATION AT HIGH ANGLES OF ATTACK
William H. Close Washington, NASA, Apr. 1960 49 p 10 refs
(NASA TM X-240) OTS: $4.60 ph, $1.67 mf (Declassified)

An investigation has been made in the Langley 11-inch hypersonic tunnel to determine the ability to trim and maintain static longitudinal stability and control of a delta-wing configuration at high angles of attack. Three-component force tests were made at a Mach number of 6.7 and a Reynolds number of 0.47×10^6 (based on a root chord) at angles of attack from 27° to 56°. It was found that the wings with the center of gravity located at 42 percent of the mean aerodynamic chord could be trimmed throughout the test angle-of-attack range without loss in longitudinal stability and control. If the center of gravity can be located farther rearward, the sometimes large losses in lift due to trimming can be avoided (as less control would then be required in order to trim) without necessarily decreasing stability. Positive nose deflections yielded small pitching-moment increments at the higher angles of attack, but were stabilizing throughout the test angle-of-attack range. Negative flap deflections produced large pitching-moment increments and were destabilizing for all angles of attack. Unported trailing-edge flaps were found to be generally less effective than the smooth-bottom flaps. A method of predicting the longitudinal characteristics is presented with typical results which show good agreement with measured data for the flat wing and wing-flap deflections. Interference effects due to the nose deflection were not predicted, however, and the predictions for nose deflections were generally not as good as those for flap deflections. Author

N63-17301 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CENTER-LINE PRESSURE DISTRIBUTIONS ON TWO-DIMENSIONAL BODIES WITH LEADING-EDGE ANGLES GREATER THAN THAT FOR SHOCK DETACHMENT AT MACH NUMBER 6 AND ANGLES OF ATTACK UP TO 25°
Theodore J. Goldberg, George C. Ashby, Jr., and James G. Hondros Washington, NASA, June 1963 56 p 5 refs
(NASA TN-D-1793) OTS: $1.50

Centerline pressure distributions were obtained for two-dimensional sharp-nose parabolic arc, circular arc, and wedge bodies having a leading-edge angle greater than that for shock detachment (aerodynamically blunt bodies) at Mach number of 6 for angles of attack up to 25°. The maximum pressure coefficient was found to increase continuously from the shock-attachment value to the stagnation value behind a normal shock between leading-edge deflection angles of 42° and 51°. Only the data for contoured bodies having leading-edge angles of 66° or greater are correlated very well by the generalized Newtonian theory. However, at all angles of attack for all aerodynamically blunt bodies having curved surfaces, the agreement between the generalized Newtonian theory and the measured values of pressure coefficient was reasonably good for surface-deflection angles above 30°. This theory can be used to predict pressures on most two-dimensional bodies by the methods shown herein. With few exceptions, at a given deflection angle the pressure distributions rearward of the maximum pressure on the lower and upper surfaces of aerodynamically blunt wedges are essentially coincident with those of wedges having higher and lower

half-angles, respectively. In addition, the pressure distributions of these wedges are in good agreement aft of the maximum pressure point with those of a flat plate at corresponding deflection angles to the lower surface above 53° and to the upper surface above 31°. Author

N63-17302 National Aeronautics and Space Administration. Langley Research Center. Langley Station, Va.
AERODYNAMIC CHARACTERISTICS IN PITCH AT A MACH NUMBER OF 2.01 OF SEVERAL WING-BODY COMBINATIONS WITH WEDGE-SHAPED BODIES LOCATED ABOVE AND BELOW A 54.5° SWEPT DELTA WING
Odell A. Morris Washington, NASA June 1963 23 p 4 refs (NASA TN-D-1823) OTS: $0.75

An investigation has been conducted at a Mach number of 2.01 to determine the aerodynamic characteristics in pitch of several model configurations with wedge-shaped bodies located above and below a 54.5° swept delta wing. The investigation included tests on bodies of wedge-shaped planform with variations in body wedge angle, body height, and body length. Measurement of the lift, drag, and pitching-moment coefficients for the various wing-body combinations were made through an angle-of-attack range of about −5° to 10°. The results of the investigation indicated that large changes in lift-drag ratio occurred as a result of the wing-body interference effects produced by the presence of the combined wedge-shaped bodies located above and below the delta wing. However, for all of the wedge-shaped bodies tested, addition of the body to the wing tended to reduce the maximum lift-drag ratio from that of the basic wing body combination. The interference effects of the two bodies in combination with the wing produced a favorable positive pitching-moment increment. For the range of body combinations tested, the magnitude of the lift-drag ratios is dependent to a great extent on the variation in body volume. Author

N63-17400 Boeing Scientific Research Labs. Flight Sciences Lab., Seattle, Wash.
ON THE OPTIMUM TRANSVERSAL CONTOUR OF A BODY AT HYPERSONIC SPEEDS
Angelo Miele and Gary R. Saaris Mar. 1963 48 p 5 refs (Flight Sciences Lab. TR-73; D1-82-0242)

The indirect methods of the calculus of variations are used to calculate the transversal contour of minimum drag for a slender body whose length and base area are given. Attention is given to both symmetrical arcs and to bodies whose symmetry and multiplicity properties are not considered. It is found that the extremal configuration depends on the friction parameter to a great extent, since the friction drag accounts for 2/3 of the total drag, and that, if the friction parameter is supercritical, the extremal solution is a circle; whereas, if the friction parameter is subcritical, any combination of circular arcs and straight lines tangent to the circular arcs is an extremal of minimum drag. D.E.R.

N63-17464 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FIN LOADS AND TIP-CONTROL HINGE MOMENTS ON A 1/8-SCALE MODEL SIMULATING THE FIRST STAGE OF THE SCOUT RESEARCH VEHICLE AT A MACH NUMBER OF 2.01
Ross B. Robinson and Emma Jean Landrum Washington, NASA, Apr. 1960 19 p
(NASA TM X-239) OTS: $1.60 ph, $0.80 mf (Declassified)

An investigation has been conducted at a Mach number of 2.01 in the Langley 4- by 4-foot supersonic pressure tunnel to determine the fin loads and tip-control hinge moments on a 1/8-scale model, simulating the first stage of the Scout research vehicle. The model was a body of revolution with cruciform, 45° delta tail fins. For the range of this investigation, hinge moment was small and varied nonlinearly with control deflection. Roll angle had no effect on the control-effectiveness parameters which were relatively constant throughout the angle-of-attack range. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-17075 Aeronautical Research Inst. of Sweden, Stockholm
MEASUREMENT OF HEAT TRANSFER, RECOVERY TEMPERATURE, AND PRESSURE DISTRIBUTION ON DELTA WINGS AT M=3
H. Thomann Dec. 1962 48 p 30 refs Presented in part at the Tenth Intern. Cong. of Appl. Mechanics, Stresa, 1960 (Sponsored by SAAB Aircraft Co.)
(FFA-93; supersedes RAE-TRANS-964 and RAE-TRANS-965)

Heat transfer, recovery temperature, and pressure distribution were measured on delta wings with varying leading-edge sweep at $M = 3$. For a wing with subsonic leading edge, the well-known vortex was formed above the suction side. Under the vortex, there was a peak in heat-transfer rate and the recovery factor was low. The heat-transfer rates on the pressure side were usually higher, since the pressure levels were higher; for low angles-of-attack, they could be predicted reasonably well with flat-plate theory, but for high angles-of-attack (11.5°), they were about 15 to 20% higher. When the leading-edge sweep was decreased, the flow started to expand around the leading edge, but the laminar boundary layer still separated from the suction side, forming a more or less pronounced vortex that had the same effect on heat transfer, recovery temperature, and pressure distribution as in the case of a subsonic leading edge. Author

N63-17450 National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.
EFFECTS OF SPOILER-SLOT-DEFLECTOR CONTROL ON THE AERODYNAMIC CHARACTERISTICS AT A MACH NUMBER OF 2.01 OF A VARIABLE-WING-SWEEP CONFIGURATION WITH THE OUTER WING PANELS SWEPT BACK 75°
Gerald V. Foster Washington, NASA, Apr. 1960 16 p 4 refs (NASA TM-X-273) OTS: $1.60 ph, $0.80 mf (Declassified)

An investigation has been conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Mach number of 2.01 to determine the aerodynamic characteristics of a variable-wing-sweep configuration equipped with a spoiler-slot-deflector control. The outboard wing panels were swept back 75°. The results indicate that the spoiler-slot-deflector control provided positive roll effectiveness which was approximately constant through the angle-of-attack range and positive yawing moments

which decreased with increase in angle-of-attack. Deflection of these controls had no appreciable effect on the longitudinal stability characteristics. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-17120 Aeronautical Research Council (Gt. Brit.)
TESTS ON THE LOSS OF VERTICAL JET THRUST DUE TO GROUND EFFECT ON TWO SIMPLE VTOL PLANFORMS, WITH PARTICULAR REFERENCE TO THE SHORT SC1 AIRCRAFT
L. A. Wyatt London, HMSO, 1963 43 p 77 refs
(ARC-R&M-3313; previously issued as ARC-20369) Available from HMSO: 16s

The net vertical thrust available to an aircraft for vertical takeoff and landing falls off with proximity to the ground. Measurements have been made of this thrust loss as a function of wing height above the ground, on plane circular and delta wings, and on a 1/16th scale model of the Short SC1 aircraft. At normal undercarriage height, the Short SC1 would lose nearly 20% of its vertical thrust, but a scheme has been developed to reduce the thrust loss to negligible proportions. Author

N63-17121 Aeronautical Research Council (Gt. Brit.)
A PRELIMINARY DATA REPORT ON GROUND PRESSURE DISTURBANCES PRODUCED BY THE *FAIREY DELTA* 2 IN LEVEL SUPERSONIC FLIGHT
T. A. Holbeche London, HMSO, 1963 96 p 7 refs
(ARC-R&M-3296; previously issued as RAE-TN-AERO-2520; ARC-20782) Available from HMSO: £1 16s

Measurements have been made of pressure disturbances on the ground resulting from approximately straight and level supersonic flight of the *Fairey Delta* 2 in the altitude range 30,000 ft to 3,500 ft above sea level, and with flight Mach numbers up to about 1.5. Pressure against time, flight histories, radar plots, and other data are given. The results, with allowance for refraction, show satisfactory agreement with the estimates of peak bang pressures and impulses given by Warren. The maximum positive and negative peak pressures recorded were respectively, +4.05 (±0.28) lb/ft^2 and −5.25 (±0.37) lb/ft^2, and the maximum impulses were respectively +0.154 (±0.011) lb sec/ft^2 and −0.148 (±0.010) lb sec/ft^2. Author

N63-17159 Michigan U. High Altitude Engineering Lab., Ann Arbor
UPPER AIR STRUCTURE MEASUREMENTS WITH SMALL ROCKETS
Leslie M. Jones Repr. from Space Research II, Proc. of the 2nd Intern. Space Science Symp., Florence, Apr. 10–14, 1961 p 1037–1048 13 refs
(NASA Contract NASw-138)

A series of two-, three-, and five-stage solid-propellant sounding rockets has been developed and flown by the University of Michigan. The two-stage Nike-Cajun has been widely applied to high-altitude research, particularly to measurements of upper air structure. This work has shown that the rocket assembly and field operations can be handled by a small crew at modest cost, thus increasing the synoptic possibilities. Results from the Michigan falling sphere and the Signal Corps grenade experiment as used on the Nike-Cajun have yielded upper air densities and temperatures at latitudes from 13.5° N to 58.7° N and shown important variations. The crucial structure problem of mean molecular weight above 100 km is being approached with a new mass spectrometer designed for small rocket use. Author

N63-17165 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF VERTICAL-TAIL MODIFICATIONS ON THE STATIC STABILITY CHARACTERISTICS AT A MACH NUMBER OF 2.2 OF A SUPERSONIC VTOL AIRPLANE MODEL HAVING A BROAD FUSELAGE AND SMALL DELTA WINGS
Ross B. Robinson and M. Leroy Spearman Washington, NASA, Apr. 1, 1961 18 p 1 ref
(NASA TM X-519) OTS: $1.60 ph, $0.80 mf (Declassified)

An investigation has been conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Mach number of 2.2 to determine the effects of various tail modifications on the stability characteristics of a model representative of a supersonic VTOL airplane. The original model had a broad fuselage, small delta wings, and twin vertical tails. The tail modifications included a centerline vertical tail having the same area as the original twin tails and the addition of twin ventral fins. The results for the configuration with the original tail indicated an initially low value of directional stability C_{n_β} that decreased rapidly with an increasing angle of attack until directional instability occurred above an angle of 4.5°. Changing to a single tail or adding ventral fins resulted in an increase in directional stability at low angles of attack. However, with increasing angle of attack, the contribution of the single tail to C_{n_β} decreased more rapidly than that for the original twin tails whereas the contribution of the ventral fins remained essentially constant. As a result, the most effective means of increasing the angle-of-attack range for positive C_{n_β} was through the addition of ventral fins to the configuration with the original vertical tail. Author

N63-17387 Svenska Flygmotor A. B., Trollhattan (Sweden)
VERTICAL TAKE-OFF OF A TIP JET ASSISTED AUTOGYRO Technical Note No. 10
M. H. Harries and S. A. Norland Dec. 1962 39 p 5 refs

This report is concerned with the determination of the air-mass flow requirements which will enable a small autogyro to take off vertically. The downwash is assumed to vary over the disc. Approximate expressions are developed for the lift and torque of the rotor without regard to aeroelastic effects, and thus the torque required at a given rotor top speed is obtained. The time of operation is also calculated, and used to obtain the total impulse, as a measure of total air mass required. For the optimum conditions —ωR = 500 ft/sec for continuous air supply, and ωR = 600 ft/sec for stored compressed air—the investigation is extended to determine actual mass flows, storage volumes, and duct sizes. It is concluded that so long as combustion of fuel in the air is applied, either the use of stored air or of continuously supplied air is practicable. In the former case, the power requirements will be set by cruising flight. In the latter, the required mass flow will demand a

powerplant of the order of 300 hp to drive a compressor in vertical flight; this power will also be available to drive a propeller in forward flight. Author

N63-17417 Sikorsky Aircraft Div., United Aircraft Corp., Stratford, Conn.
DESIGNING HELICOPTER AND VTOL TRANSPORTS
E. F. Katzenberger, H. D. Ulisnik, P. J. Williams, and A. A. Wolf, Jr. *In* NASA. Manned Spacecraft Center, Houston, Tex. Manned Orbital Operations Spec. Section [1963] p 100–106 5 refs (See N63-17401 15-32)

The advantages of helicopters and VTOL aircraft for intercity transport in the future are pointed out, and the economic potential of such systems is considered. It is found that VTOL aircraft are relatively free from fixed-wing traffic patterns and that greater freedom is afforded in the location of landing and takeoff areas. An analysis of current air traffic and airports is included, and the research problem areas for VTOL aircraft—materials, structures, aeroelasticity and loads, aerodynamics, guidance and control, noise, and propulsion—are listed. D.E.R.

N63-17465 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE ROLLING STABILITY DERIVATIVES OF TWO HYPERSONIC GLIDERS OF PARABOLIC PLAN FORM AT HIGH SUBSONIC SPEEDS
Donald D. Arabian Washington, NASA, Apr. 1960 48 p 4 refs (NASA TM X-268) OTS: $4.60 ph, $1.64 mf (Declassified)

An experimental investigation was conducted to determine the characteristics of the stability derivatives, damping in roll and yawing moment due to rolling velocity about the stability axes, of two hypersonic glider models of aspect ratio 0.62 and 1.25. The models were parabolic in planform with flat undersurfaces and semielliptical cross sections. The results for a range of Mach numbers from 0.4 to 0.9, with angles-of-attack up to about 15° and roll rate up to 37 radians per second, indicated linear characteristics of the basic force and moment data. The effect of model geometry on the derivatives was appreciable, and the trends with angle-of-attack and Mach number are shown. The contribution of a vertical tail on the aspect-ratio-0.62 model is indicated. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-17108 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVIDENCE FROM THE MOON'S SURFACE FEATURES FOR THE PRODUCTION OF LUNAR GRANITES
John A. O'Keefe and Winifred Sawtell Cameron *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 61–83 40 refs Submitted for Publication (See N63-17105 15-29) OTS: $3.50

The evidence for granitic rocks from the morphology of the moon's surface is considered in this paper. The displacement of the center of the moon's visible surface with respect to the center of mass is considered evidence of isostasy on the moon. It is shown that this displacement is not merely a limb phenomenon, and is probably not explicable in terms of the kind of lumpy interior proposed by Urey to explain the differences of the moments of inertia. Evidence for characteristic granite topographic features, including tholoids and laccoliths, is summarized. The possibility that the maria were produced by the fluidization of volcanic ash is considered. The transporting fluid is considered to be the contained gases as in a terrestrial ash flow. Ash flows on the earth are responsible for the emplacement of a large fraction of all volcanic ash. From a study of the physics of ash flows, it is determined that the fluidization should be even more effective on the moon. It is concluded that the morphology of the moon's surface does not contradict the notion that large amounts of acid rock are present on its surface. Author

N63-17170 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
COMMENTS ON CORONAL HEATING
E. N. Parker Repr. from Solar Corona, Academic Press, Inc., 1962 p 11–19 19 refs
(NASA Grant NsG-96-60)
(NASA-CR-50142)

The mechanical motions generated in the convective zone beneath the photosphere which are capable of propagation into the solar corona, and the mechanisms in the corona which dissipate these motions and generate heat are discussed. The modes or motions are: the hydromagnetic wave, the acoustical wave, and the internal gravity wave. The mechanisms by which heat is generated are: the steepening into shocks and self-dissipation, thermal conductivity, and the settling of helium ions. The conditions in the solar corona are discussed with special emphasis placed on the stratification of ionic species and the effects of stirring and helium drift. It is concluded that whenever the outer solar corona are stirred well enough to avoid the hydrostatic stratification of ionic species, one of the most important heating mechanisms must be the friction created by the rapid settling of helium ions. D.E.R.

N63-17244 Space Technology Labs., Inc., Redondo Beach, Calif.
NEW EXPLORATIONS, NEW RESULTS (1961 TUNGUSKA EXPEDITION) (NOVYE POISKI, NOVYE RESULTATY)
K. P. Florenskii and I. T. Zotkin Dec. 1962 Transl. into ENGLISH from Priroda (Moscow), no. 8, Aug. 1962 p 31–39 9 refs (Rept. 9990-6346-KU-000; STL-TRANS.-71)

The astronomical characteristics of the Tunguska meteorite body recently uncovered as a result of postwar investigations of the fall area are discussed, and a map of the area is included. From the investigations, the velocity of the projectile, its mass, size, approximate composition, temperature, and the shock-wave temperature are estimated. D.E.R.

N63-17314 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY IX: THE DARK SIDE AIRGLOW OF VENUS
Neville Jonathan and George Doherty Feb. 1963 44 p 6 refs (NASA Contract NASw-395)
(NASA CR-14; GCA-TR-63-1-N) OTS: $4.60 ph, $1.52 mf

The luminescence on the dark side of Venus, strong emissions in the region 4400 A to 4410 A, is analyzed to determine whether it is a product of chemical reactions. The results of several investigations of the chemiluminescence arising from the reaction of carbon monoxide with atomic oxygen are summarized and compared. A mechanism is proposed to explain the airglow which involves two distinct two-body reactions resulting in the formation of both radiative and nonradiative carbon dioxide molecules. A recommendation is made to study the reactions at higher temperatures but it is noted that, at room temperatures, the luminescence is a factor of 2000 less than that caused by the O + NO reaction. D.E.R.

N63-17341 California U., La Jolla. Scripps Inst. of Oceanography
METEORITIC DEBRIS FROM THE SOUTHERN CALIFORNIA DESERT
Robert Gowdy (NEL) and Kurt Fredriksson Repr. from Geochim. Cosmochim. Acta, v. 27, 1963 p 241–243 8 refs
(NASA Grant NsG-98-60)
(NASA-CR-50327)

During an examination of magnetic material from California desert sand, two meteoritic particles were found. One was a typical cosmic spherule consisting of nickel–iron with an iron–oxide shell; that is, it was an iron–oxide spherule with a metallic inclusion or nucleus. The other contained 85 percent magnesium–iron silicate and 15 percent nickel–iron. Both particles were analyzed with an electron microprobe, and their meteoritic character was noted. — Author

N63-17345 Observatorium Bosscha, Bandung (Indonesia)
REPORT FOR THE YEAR 1962
Pik-Sin The [1962] 4 p 4 refs

The photographic observations of visual double stars are being continued. Survey data are presented of Hα-emission objects of the regions in Acquila, Scutum, and the southern Coalsack; east of the Coalsack; east of the T-association near Sco; and the galactic center. Photometric data on the study of the galactic cluster, NGS 6649, 6124, and 6405, are given. A method was developed for the correction of background effect in photographic photometry using an Eichner photometer. N.E.A.

N63-17455 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EPHEMERIS FOR THE STABLE LIBRATION POINTS OF THE EARTH-MOON SYSTEM FOR OCTOBER 1962 TO DECEMBER 1963
William R. Wells and William H. Michael, Jr. Washington, NASA, May 1963 13 p 5 refs
(NASA TM X-814) OTS: $0.50

An ephemeris giving the position and mean variation per hour in the position of the two stable libration points L_4 and L_5 of the earth–moon system has been constructed for those days of each month for which the illumination is favorable for viewing possible particle clouds in the vicinity of these points. (The libration point L_4 leads the moon's motion about the earth by 60°, and L_5 lags by 60°.) The ephemeris covers the last quarter of 1962, and entire calendar year of 1963. Simple construction of the ephemeris was possible because of the assumption of planar motion of the moon for large parts of the month and the employment of existing ephemerides giving the position of the moon. Author

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-17088 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ATTITUDE CONTROL SYSTEMS: AN ANNOTATED BIBLIOGRAPHY [1957-MAY 1962]
Helen M. Abbott, comp. Aug. 1962 69 p 155 refs
(Contract AF 04(647)-787)
(Rept. 3-77-62-20; SB-62-26)

This bibliography contains 155 selected references pertaining to attitude-control systems of satellites. Information gained from these references presented state-of-the-art capabilities in the area of stabilization of earth satellites. Author

N63-17089 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ACTIVE THERMAL CONTROL OF SPACECRAFT SURFACES: AN ANNOTATED BIBLIOGRAPHY [1959-1962]
H. M. Abbott, comp. Sept. 1962 21 p 46 refs
(Rept. 8-17-62-1; SB-62-30)

This bibliography contains 46 selected references pertaining to information on active thermal control of spacecraft surfaces. Active controls have moving parts such as heaters, louvers, shutters, discs that turn, and cylinders that rotate the vehicle to change its exposure to the sun, earth, etc. Also included are references that make a comparison between active and passive thermal-control performance. Author

N63-17102 Kellett Aircraft Corp., Willow Grove, Pa.
EVALUATION OF A HELICOPTER-FUSELAGE-MOUNTED DYNAMIC-NEUTRALIZER STATIC ELECTRICITY DISCHARGING SYSTEM Technical Report [Jan.–July 1962]
Juan de la Cierva Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1962 61 p 4 refs
(Contract DA-44-177-TC-843)
(TCREC-TR-62-93)

A static electricity discharging system known as the dynamic neutralizer, has been designed, built, and flight tested, and the results are presented. The dynamic neutralizer had been previously tested in a rotor-blade-mounted version. The program discussed in the present report was concerned with the evaluation of this discharger when installed in the fuselage of an Army H-37 helicopter. The test data confirm that the principle of operation of the dynamic neutralizer is not affected by locating the entire device in the fuselage. Author

N63-17148 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PERFORMANCE OF SPECTRALLY SELECTIVE COLLECTOR SURFACES IN A SOLAR-DRIVEN CARNOT SPACE-POWER SYSTEM
C. H. Liebert and R. R. Hibbard Repr. from Solar Energy, v. 6, no. 3, July 1962 p 84–88 7 refs

A study was made of the theoretical performance of spectrally selective surfaces when used as the collectors of solar energy for driving heat-engine cycles in space. Selective surfaces were considered for which the monochromatic emissivity changed abruptly at specific wavelengths between 0.5 and 10 microns. The Carnot cycle was used as the heat engine, and waste heat was rejected from a black radiator. Systems using both focused and unfocused radiation were considered. It was found that spectrally selective surfaces hold considerable promise as collectors of solar energy in unfocused systems. The efficiency for these is several times greater than that obtainable from black or gray collectors. However, this advantage of spectral selectivity diminishes if the sunlight is focused on the collector. In highly focused systems, such as those using parabolic mirrors, black collectors give substantially the same efficiency as the most ideal spectrally selective surface. Author

N63-17280 Atomics International. Compact Systems Div., Canoga Park, Calif.
SNAP RELIABILITY PROGRAM
William R. Vaughn and Chris J. Brous *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 157–177 16 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf
(Contract AT(11-1)-GEN-8)

The reliability of nuclear power systems for space applications is one of the important factors that will make this energy source practical. The study of environmental effects on the reliability of these space systems and their electronic payloads involves not only the usual conditions of space, but adds to it the requirements for long-term endurance and radiation resistance. A simplified analytical technique has been developed which uses available test and performance data and requires limited additional testing. This program should provide reliable systems for nuclear auxiliary power (SNAP) that will be suitable for the space-payload and electrical propulsion requirements of the larger systems of the late 60's and 70's. Author

N63-17290 Space-General Corp., El Monte, Calif.
DESIGNING RELIABILITY IN SPACECRAFT SOLAR POWER SUPPLIES
Irving Doshay and William F. Emrich *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 311–320 11 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Considerations of both catastrophic failures and degradation of solar-power devices are included. Two design concepts have been prepared, each of which encompasses techniques of redundancy to obtain a high level of reliability. The reliability goal selected for this design is 99% for a lifetime of one year. A design reliability analysis is made of each of the alternative designs. Reliability techniques are used in deciding between the designs. Sample calculations are included for the effects of redundancy, as well as environmental effects such as radiation and meteorite damage. Tables and graphs are presented covering the effects of radiation and meteorite damage. All sample calculations, tables, and graphs presented have been specifically selected to provide an aid to the design engineer for use in the design of solar-power supplies. Author

N63-17291 Air Force Systems Command. Space Systems Div., Los Angeles, Calif.
ACHIEVEMENT OF RELIABILITY IN SPACE SYSTEMS
Harvey W. Fritz *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 321–331 4 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The relative reliability requirements for aircraft, missile, and space systems are presented. It is found that the space systems must achieve a higher level of reliability than either aircraft or missile systems. The use of the safety factor and safety margin concepts is recommended for future designs of space systems to achieve a high degree of reliability. D.E.R.

N63-17297 Vickers, Inc., Detroit, Mich.
HYDRAULIC CONTROL RELIABILITY IN SPACE VEHICLES
A. B. Billett *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 401–422 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper is concerned with the reliability of hydraulic controls on present missiles and space vehicles. The special techniques and problems that required solving are reviewed to meet the high reliability requirements of the control systems of the Minuteman, Atlas, Polaris, and Skybolt vehicles. This has resulted in the development of new reliability techniques and analyses to meet these requirements. Author

N63-17365 Melpar, Inc., Falls Church, Va.
A FREQUENCY MODULATED PHASE-SHIFT OSCILLATOR
Charles Feldman and Harry E. Culver *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 189–138 6 refs (See N63-17351 15-09) OTS: $5.00

A study is made of thin-film integrated circuits capable of operating to 500° C and possessing a high degree of radiation resistance. Effort has been concentrated on the preparation and properties of materials capable of operating at high temperatures and on the study of the various physical phenomena and effects in these materials that may lead to circuit functions. Work on metal film resistors confirms the fact that rhenium forms a very suitable film resistor which is capable of operating at 500° C. Films with mobilities as high as 600 $cm^2/v\text{-}sec$ are formed at substrate temperatures of approximately 750° C. The increase in mobility is brought about by the use of a substrate with an expansion coefficient similar to that of germanium. The studies on materials and effects are brought together in the fabrication of a frequency-modulated phase-shift oscillator. J.R.C.

N63-17433 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTROCHEMICAL FUEL CELLS: AN ANNOTATED BIBLIOGRAPHY [1961-1962]
Scott J. Buginas, comp. Dec. 1962 60 p 117 refs
(Rept. 2-99-62-5; SB-62-51)

This bibliography concerning Electrochemical Fuel Cells consists, for the most part, of references dated late 1961 and the first 9 months of 1962. Author

N63-17443 Atomics International, Canoga Park, Calif.
THERMIONIC CONVERTERS FOR COMPACT NUCLEAR POWER PLANTS
N. S. Rasor and C. C. Weeks Aug. 1, 1962 92 p 28 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7144) OTS: $2.00

A brief review of several thermionic nuclear powerplants leads to the conclusion that the in-core concept is the most practical and useful system for space applications. Fundamental considerations indicate that emitter temperatures from 1500° to 1900° C are required for this concept, and that the high-work-function refractory metals are the best electrode materials for achieving the required performance and lifetime at these temperatures. The analytical and experimental technology developed for systematically defining the optimum materials and operating conditions is described, along with the significance of the experimental results obtained. These results have shown that the required performance can be obtained with the elementary cesium vapor diode converter. It has also been shown that impurities cause pronounced effects on both performance and lifetime, and that their suppression or controlled utilization is an important aspect of the present approach. Author

N63-17486 National Advisory Committee for Aeronautics. Lewis Flight Propulsion Lab., Cleveland, Ohio

EXPERIMENTAL INVESTIGATION OF A 7-INCH-TIP-DIAMETER TRANSONIC TURBINE

Warren J. Whitney and William T. Wintucky Washington, NACA, Jan. 16, 1958 15 p 4 refs

(NACA RM E57J29) OTS: $1.60 ph, $0.80 mf (Declassified)

The overall performance results have been obtained for a 7-inch transonic turbine, and the results are compared with those of a 14-inch turbine of geometrically similar design that was previously investigated. The peak efficiency obtained with the turbine was 0.85, which was 2 points lower than that obtained previously with the 14-inch turbine. The difference noted in overall performance as a result of decreasing the tip diameter from 14 to 7 inches was considered significantly small. The difference could not be interpreted theoretically as a Reynolds-number effect. Therefore, the size effect on performance is believed to be due largely to the inability to fabricate the smaller blades to the same percentage of dimensional deviation as that of the larger blades. Author

N63-17473 Frankford Arsenal, Philadelphia, Pa.

DEVELOPMENT OF LOW ENERGY DETONATING CORD FOR EMERGENCY CREW ESCAPE SYSTEMS

W. R. Peterson Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 64 p refs

(Contract AF 33(616)-59-14)

(FA-R-1641; ASD-TDR-63-54)

Frankford Arsenal has developed fittings and initiators for the use of Low Energy Detonating Cord (LEDC) to obtain improved energy transmission for emergency crew-escape systems in aerospace vehicles. The systems developed are also capable of being retrofitted to existing escape systems for service aircraft. Test systems, using Propellant Actuated Devices (PAD) such as initiators, thrusters, removers, catapults, etc., have been successfully fired using LEDC as a replacement for propellant-gas-transmission hose. The advantages of LEDC initiation, compared to other methods, are reduced size and weight, higher operating speeds, and assurance of transmitting energy any desired distance without line boosters. The LEDC system is totally independent, requiring no power supply. It is safe to handle because it requires a specific means of initiation.

Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-17011 Rochester U., N.Y.

THE TRANSFER OF ELECTRONIC ENERGY FROM BENZENE TO BIACETYL

Hidehiko Ishikawa (Ph.D. Thesis) 1962 145 p 117 refs

In this work benzene is used as an energy donor and biacetyl as an energy acceptor. A study of energy transfer from benzene vapor to biacetyl vapor, after the former has absorbed radiation at 2537 A, has revealed two phenomena of photosensitization: (1) the sensitized decomposition of biacetyl (however, not conclusively); (2) the sensitized emission of biacetyl. The sensitized decomposition of biacetyl may be explained as a result of energy transfer from singlet-excited benzene to biacetyl exciting the latter to the second-upper-singlet state. The data of the emission of biacetyl sensitized by benzene may be best treated by assuming the presence of triplet-state benzene in high concentration which will be formed from singlet-excited-state benzene by intersystem crossing. As a mechanism of sensitized biacetyl emission, energy transfer from triplet benzene to biacetyl is proposed. Author

N63-17019 Air Force Special Weapons Center, Kirtland AFB, N. Mex.

HIGH-TEMPERATURE DESTRUCTIVE TESTING OF PLUTONIUM-FUELED CAPSULES FOR A THERMOELECTRIC CONVERTER

John C. Clifford May 1963 46 p 12 refs

(AFSWC-TDR-62-121)

Plutonium-fuel capsules, designed for use in a thermoelectric SNAP device, were exposed to high-temperature oxidizing environments to evaluate the effects on capsule integrity, and to determine the quantity and characteristics of alpha activity released during destruction of capsules. For test purposes, plutonium-239 was substituted for the normal plutonium 238 fuel charge. Capsules which survived the tests were examined by radiographic and metallographic techniques to determine the degree of damage sustained. Residues from destroyed capsules and filter papers from a 90° segment, 800-meter air-sampling network were analyzed radiochemically to determine the quantities and characteristics of the released alpha activity. Because of the confined test configuration, massive alloying to plutonium and capsule components was observed when capsules were destroyed. As a result, the fraction of plutonium which escaped to the atmosphere was small, on the order of 10^{-4} of the initial charge. From cascade impactor samples of this airborne debris, it was estimated that 90 percent of the alpha activity was associated with material of 1.5 micron median diameter or less. Author

N63-17025 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

NEW METHODS OF SYNTHESISING HEAT RESISTANT POLYMERS HAVING RINGS IN THE CHAIN (NOVYE METODY SINTEZA TERMOSTOIKIKH POLIMEROV S TSIKLAMI V TSEPI)

M. M. Koton London, Ministry of Aviation, Mar. 1963 25 p 47 refs Transl. into ENGLISH from Usp. Khim. (SSSR) 31, 1962 p 153-167

(RAE-TRANS-1028)

Exploratory investigations on the synthesis of extremely heat-resistant polymers are being extended, and new methods of synthesizing heat-resistant polymers is through the synthesis of polymers containing carbon and heterocyclic rings in the basic chain. The present review examines progress achieved in the last two years in the synthesis of new, extremely heat-resistant polymers having rings in the chain. Author

N63-17060 Reaction Motors Div., Thiokol Chemical Corp., Denville, N.J.

DETECTION OF HYDROGEN-AIR FIRES AND EXPLOSIONS IN AEROSPACE VEHICLES VIA OH BAND AND WATER BAND EMISSION [Final Report, June 1-Nov. 1962]

K. Hill and B. Hornstein Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Apr. 1963 105 p 39 refs
(Contract AF 33(657)-8969)
(ASD-TDR-63-113)

To provide a basis for reliable hydrogen-air fire and explosion detection in aerospace vehicles, measurements of the absolute value of radiant intensity were made over the OH bands of the ultraviolet and the water bands in the infrared. A surprising result was the increase in OH radiant intensity with decreasing pressure. Diffusion flame variables were hydrogen flow rate, port diameter, and pressure from 760 to less than 20 mm Hg. For explosions, mixture ratio as well as pressure were varied; the rate of increase of emission and pressure after ignition were measured to determine detection lead time. Results, where possible, are presented as fundamental quantities which can be applied with reasonable rigor to a variety of design situations. Detection based upon monitoring OH radiation is recommended over other properties such as IR radiation, ionization, temperature rise, or pressure rise. Application of the data to specific designs is discussed. Author

N63-17123 Houston U., Tex.
SYNTHESIS OF ORGANIC COMPOUNDS BY ELECTRIC DISCHARGES
J. Oró (Calif. U.) Repr. from Nature, v. 197, no. 4870, Mar. 2, 1963 p 862-867 26 refs
(NASA Grant NsG-257-62)
(NASA CR-50300)

Some amino-acids, hydroxy acids, and a few other organic compounds have been synthesized by the prolonged action of spark discharges on mixtures of methane, ammonia, and water. To increase the probability of obtaining new compounds, ethane was added to the reactant mixture so as to yield some ultraviolet absorbing compounds. The products included glycine, alanine, aspartic acid, asparagine, isoleucine, glycinamide, yellowish oil, an insoluble polymer, several UV-absorbing compounds, peptides, and possibly proline and complex lipophilic molecules. D.E.R.

N63-17187 Radiation Applications, Inc., Long Island City, N.Y.
DEVELOPMENT OF TRANSPARENT PLASTIC MOISTURE BARRIERS BY RADIATION-INDUCED GRAFT POLYMERIZATION [Summary] Report, 1 Dec. 1960-31 Aug. 1962
Sept. 5, 1962 34 p 4 refs
(Contract NOw-61-0407-C)
(RAI-303)

This project has been concerned with the synthesis of new packaging materials having high moisture-barrier properties. The grafting of pure vinylidene chloride to polyethylene is quite inefficient due to the difficulty in separating the grafted product from the homopolymer. This problem has been overcome by employing vinylidene chloride diluted with a small amount of acrylonitrile. Facile graft polymerization occurs in the latter case. It has been found that the graft polymers so formed have markedly reduced WVTR values compared to untreated polyethylene. Appreciable amounts of chlorotrifluoroethylene have been grafted to polyethylene. This did not result in a lowering of the WVTR value due to the degradation of the graft during irradiation. Author

N63-17204 General Mills Electronics Group, Minneapolis, Minn.
SPUTTERING EFFECTS ON THE MOON'S SURFACE Third Quarterly Status Report, Oct. 18, 1962-Jan. 17, 1963
G. K. Wehner Jan. 30, 1963 27 p 17 refs
(NASA Contract NASw-424)
(NASA CR-50229; Rept. 2364) OTS: $2.60 ph, $1.01 mf

Sputtering yields of various terrestrial rocks under Hg^+-ion bombardment of several hundred ev energy were determined with a high-frequency sputtering method. Yields by volume are found to be in the same range as that of Fe, a medium sputtering rate metal. Sputtering yields of metals and oxides were determined with a method where mass separated hydrogen beams (H^+, H_2^+, and H_3^+) at ~7 Kev sputter holes into thin target foils. The method and results are described in detail. Ion-bombarded powder samples produce a surface which has photometric properties which are very similar to those required from moon-surface studies. Recent literature data on the solar wind, especially from Mariner II, and our new experimental sputtering yields are incorporated in a revised table on lunar sputtering rates. Author

N63-17215 Detroit U., Mich.
SYNTHESIS OF PORPHINE-LIKE SUBSTANCES DURING CHEMICAL EVOLUTION
Anton Szutka [1962] 15 p 28 refs For Presentation at the Radiation Res. Soc. Ann. Meeting, Milwaukee, Wisc., May 27-29, 1963
(NASA Grant NsG-226-62)
(NASA-CR-50200) OTS: $1.60 ph, $0.80 mf

Porphine-like substances were synthesized in the presence of oxygen from simple precursors available in the early stages of chemical evolution. A mixture of benzaldehyde, pyrrole, and water was irradiated using gamma rays and then treated with chloroform and sodium sulfate to form the porphine. The same mixture produced porphines when placed in the dark without irradiation. Thus, an important step in the evolution preceding the appearance of life may be established, which enabled the processes of fermentation, respiration, and photosynthesis, and the metabolism of sulfates, iron, nitrogen, hydrogen, and oxygen to occur. D.E.R.

N63-17219 Aeronutronic, Newport Beach, Calif.
EXPERIMENTAL STUDIES FOR THE DETECTION OF PROTEIN IN TRACE AMOUNTS Final Technical Report
R. E. Kay Mar. 1963 81 p 26 refs
(NASA Contract NASr-84)
(NASA-CR-50385;U-2062) OTS: $8.10 ph, $2.63 mf

A method of detecting biological macromolecules, based upon the observation of spectral changes due to aggregation of a dibenzo-thiacarbocyanine dye when it is adsorbed on the macromolecular structure, was investigated. The reactions of the dye with inorganic salts, microorganisms, pollen, polypeptides, simple proteins, conjugated proteins, synthetic polypeptides, polynucleotides, carbohydrates, amino acids, pyrimidine and purine bases, nucleosides and nucleotides were investigated. In trace amounts (less than 0.002 percent), only proteins, synthetic polypeptides, nucleic acids, microorganisms, pollen, and substituted polysaccharides cause changes in the absorption spectrum of the dye. The influence of such variables as pH, temperature, and dye-macromolecule stoichiometry on the stability and formation of the dye-macromolecule complexes and dye aggregates was also determined. The optimum conditions for dye-macromolecule formation and stability appear to be a pH of 7 to 9, dye concentration of 4×10^{-5}M, and a temperature of 20° to 40° C. The relationship of macromolecule structure to the absorption spectrum of the macromolecule-dye complex was examined; it was found, especially in the case of DNA, that the nature of the absorption spectrum of the dye-macromolecule complex could give significant information about the structure of the macromolecule. The macromolecule-dye reaction was investigated for its applicability to

detection of macromolecules in heterogeneous materials by observing its behavior with soil extracts and suspensions of microorganisms. Author

N63-17235 Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio
THE SPECTROCHEMICAL DETERMINATION OF BORON IN MOLYBDENUM [Final Report, Oct. 1962-Feb. 1963]
James H. Muntz Apr. 1963 13 p 5 refs
(ASD-TDR-63-290)

A method for the spectrochemical determination of boron in molybdenum is described. The method provides for the determination of boron in the 50- to 500-ppm range by a carrier-distillation technique, with a precision of ±10 percent. Author

N63-17313 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VIII: A CONGERIES OF ABSORPTION CROSS SECTIONS FOR WAVELENGTHS LESS THAN 3000 Å
E. D. Schultz, A. C. Holland, and F. F. Marmo Nov. 1962 103 p 106 refs
(NASA Contract NASw-395; Contract AF 33(657)-9199)
(NASA CR-15; GCA-TR-62-15-N) OTS: $9.10 ph, $3.29 mf

Experimental data on the absorption of solar vacuum ultraviolet radiation by atmospheric gases, which is of primary importance in the study of planetary aeronomy, is compiled. Available absorption curves and tabulations, in the spectral region from 100 A to 3000 A, of various authors were collected and identified. Summaries of these authors' studies are included and the respective spectral regions studied are given. An accompanying discussion of the absorption characteristics, together with a historical sketch of each gas considered, is presented. N.E.A.

N63-17316 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XI: ABSOLUTE INTENSITY MEASUREMENTS IN THE VACUUM ULTRAVIOLET
J. A. R. Samson Mar. 1963 28 p 6 refs
(NASA Contract NASw-395)
(NASA CR-7; GCA-TR-63-3-N) OTS: $2.60 ph, $1.04 mf

Absolute intensity measurements of vacuum ultraviolet radiation are made using the technique of photoionizing rare gases and assuming that their photoionization yield is unity. It was concluded that the relative photoionization yields of the rare gases with respect to one another is unity. Therefore, absolute intensity measurements will be independent of the rare gas that is used, provided that proper experimental care is observed. N.E.A.

N63-17320 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XIV: ULTRAVIOLET ABSORPTION OF SO_2: DISSOCIATION ENERGIES OF SO_2 AND SO
P. Warneck, F. F. Marmo, and J. O. Sullivan May 1963 25 p 17 refs
(NASA Contract NASw-701)
(NASA CR-10; GCA-TR-63-13-N) OTS: $2.60 ph, $0.95 mf

The absorption intensities of SO_2 were measured in the wavelength region 2000 to 3100 A, employing the hydrogen continuum as the source and at selected wavelengths utilizing the mercury line spectrum. The pressure dependence of the absorption intensity was investigated at 1849, 2537, and 3131 Å. The existence of an absorption continuum in the spectral region 1700 to 2300 Å has been established, and attributed to the dissociation of SO_2 forming SO and a ground state oxygen atom. The onset of the continuum provides an upper limit value to the dissociation energy of SO_2. The implications upon the SO_2 and SO dissociation energies are discussed. Author

N63-17337 Electric Boat Div., General Dynamics Corp., Groton, Conn.
THE INORGANIC OZONIDES
A. W. Petrocelli and R. V. Chiarenzelli [1962] 5 p 37 refs Repr. from J. Chem. Educ., v. 39, Nov. 1962 p 557-560
(NASA Contract NASw-559)
(NASA-CR-50118)

A review of the chemistry of the inorganic ozonides is presented, and those areas where additional research is necessary to give a more definitive knowledge of these compounds are pointed out. The following are discussed: (1) the discovery of the ozonides, (2) recent development in ozonide research—the Russian work, (3) ozonide stability, (4) the reaction of ozonides with water, and (5) ammonium ozonide. N.E.A.

N63-17379 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
THE THIRD CONFERENCE ON NUCLEAR REACTOR CHEMISTRY HELD IN GATLINBURG, TENNESSEE, OCTOBER 9-11, 1962
W. R. Grimes, C. J. Barton, and J. P. Blakely [1962] 398 p refs
(Sponsored by Oak Ridge Natl. Lab.)
(TID-7641) OTS: $4.50

Articles on (1) particle and fission product behavior in nuclear reactor accidents, (2) the role of analytical chemistry in nuclear reactor chemistry, (3) chemical problems of organic cooled reactors, (4) the preparation and properties of reactor core materials, and (5) corrosion chemistry of reactor materials are presented. D.E.R.

N63-17386 National Lead Co. of Ohio, Cincinnati
ELECTRON BEAM MELTING OF URANIUM
H. M. Eikenberry June 14, 1963 24 p 3 refs
(Contract AT(30-1)-1156)
(NLCO-881) OTS: $0.75

Feed stock prepared from ingot, dingot, and under-salt-melted uranium was melted by electron bombardment. Analysis of the ingots produced revealed that some aluminum, chromium, magnesium, manganese, and lead were volatilized from the melt. Carbon was reduced when zirconium was present in the feed material. Hydrogen and nitrogen also were removed, the latter only when there was a relatively high concentration in the feed material. The work indicated the need for very slow melting rates, or the casting of large diameter ingots for successful refinement of uranium. Author

N63-17399 RAND Corp., Santa Monica, Calif.
CONDITIONS FOR A HOMOGENEOUS MIXTURE TO BE IDEAL
N. Z. Shapiro June 1963 15 p 1 ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-3677-PR)

This memorandum considers homogeneous mixtures of three or more chemical species, obtaining conditions for such mixtures to be "ideal" over some range of chemical compositions. Temperature and pressure are assumed constant. Ideality is shown to derive from the assumption that for each species, the activity of the species depends only on the concentration of that particular species, independently of the concentrations of the other species. Author

N63-17426 United Nuclear Corp. Development Div., White Plains, N. Y.
DEVELOPMENT OF A CONTINUOUS METER FOR OXYGEN IN SODIUM Quarterly Progress Report, Mar. 1, 1962-May 31, 1962
H. Steinmetz July 15, 1962 18 p 4 refs
(Contract AT(30-1)-2877)
(UNC-5028)

In current experiments an electrochemical cell was operated satisfactorily for 1100 hours at 500° to 600° F. The electrochemical cell was found to give a good response to changes in oxygen concentration at temperatures of 550° F and 650° F. The response was poor at 750° F, whereas at 900° F there was little or no response. Preliminary measurements yield values for the temperature coefficient of this cell in the range of −0.41 to −0.62 millivolts/° F. Author

N63-17428 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
A STUDY OF COPPER OXIDATION AND SOME IRRADIATION EFFECTS Final Report
J. Martin Tobin Washington, AEC Div. of Tech. Information, Feb. 6, 1963 46 p 22 refs
(Contract AT(04-3)-407)
(GA-3349) OTS: $1.25

A new volumetric apparatus and a procedure for the study of the kinetics of oxidation of metals in a nuclear reactor are described. Measurements have been made on the initial stages of oxidation of 99.999% pure, polycrystalline copper wires at temperatures from 100° to 300° C. The oxygen gas was held at constant pressures during each isothermal oxidation. The pressures employed ranged from 50 to 200 mm Hg. A significant increase in logarithmic oxidation rate was observed in the presence of 2×10^6 r/hr of gamma irradiation in the temperature range 100° to 250° C. The effect of temperature on the parabolic rate constants was found to obey the Arrhenius equation. The activation energy was found to be from 0.73 to 0.82 ev. The logarithmic rate constants were found to be independent of temperature. The latter behavior is explained on the basis of the Bénard concept. The effect of pressure was observed to be marked in the early part of the oxidation. Increased pressure of oxygen decreases the transition time and thickness where the change from parabolic to logarithmic rate behavior occurs. Author

N63-17431 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio
CARBONIZATION OF PLASTICS AND REFRACTORY MATERIALS RESEARCH [Technical Report, July 1, 1960-June 30, 1961]
J. A. Coffman, G. M. Kibler, T. F. Lyon, and B. D. Acchione Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Jan. 1963 190 p 14 refs
(Contract AF 33(616)-6841; ARPA Order 24-60)
(WADD-TR-60-646, Pt. II)

Studies of thermal degradation of phenolic, epoxy, polyphenylene, and polynaphthalene resins were made utilizing the arc-image furnace, the fluidized bed reactor, and the thermogravimetric analysis technique. The effect of semicarbonized materials used as fillers has been studied, and a Bendix time-of-flight mass spectrometer has been adapted to the study of transient and stable species resulting from the flash-photolysed degradation of plastics. Properties of carbon residues have been measured. Vapor-pressure studies using the Langmuir evaporation technique, the matrix isolation method, and resonance line absorption spectroscopy have progressed. Rates of evaporation of tungsten carbides, hafnium carbide, and titanium carbide have been measured; further conclusive measurements on zirconium carbide have been made. Preliminary application of the matrix isolation technique to thoria has been made. Resonance line absorption studies have been completed on zirconium carbide and titanium carbide, and the accessible thermodynamic data have been deduced. Normal spectral emissivities of W-2 coated molybdenum, siliconized ATJ graphite, tantalum, molybdenum, tungsten carbide, and zirconium have been measured in the temperature range 1400° to 3100° K. Author

N63-17440 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH, 1963
Russell W. Dayton and Ronald F. Dickerson Apr. 1, 1963 85 p refs
(Contract W-7405-eng-92)
(BMI-1624(Del.)) OTS: $2.00

Research progress relating to civilian application is reported. The report covers the following areas: (1) reactor materials and components, (2) studies of fuels, (3) general fuel-element development, (4) radioisotope and radiation applications, (5) development of tracer system for in-place filter evaluation, (6) development of materials to be used in conjunction with construction of the New Production Reactor and operation of the Plutonium Recycle Test Reactor, (7) coated-particle fuel materials, (8) corrosion studies of the fluoride-volatility process, (9) long-term creep-rupture program on SAP alloys, (10) fission-product deposition studies, (11) irradiation of materials and components, (12) gas-cooled reactor program, (13) properties of F-48 niobium alloy, and (14) joining of regenerative cell components. N.E.A.

N63-17453 Bureau of Mines. Berkeley Thermodynamics Lab., Calif.
HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF SESQUIOXIDES OF LUTETIUM, DYSPROSIUM, AND CERIUM
L. B. Pankratz and K. K. Kelley 1963 11 p 5 refs
(BM-RI-6248)

High-temperature heat-content values of pure lutetium sesquioxide and dysprosium sesquioxide were measured over the temperature range from 298° to 1,800° K. Similar data for cerium sesquioxide were calculated from measurements of a mixture of cerium sesquioxide and dioxide and known values for cerium dioxide. The results for lutetium sesquioxide are regular. Dysprosium sesquioxide has a minor thermal anomaly near 1,590° K, the extra heat absorption being 220 cal/mole. Hexagonal cerium sesquioxide undergoes a transformation around 1,050° K, which is only slowly reversible; consequently, results were obtained for both the low- and high-temperature varieties. The original heat-content data are reported, and smooth values of heat content and the corresponding entropy increments are tabulated. Equations are derived to represent the heat-content values. Author

N63-17454 Bureau of Mines. Berkeley Thermodynamics Lab., Calif.
HEATS OF FORMATION OF GEHLENITE AND TALC
Ronald Barany 1963 12 p 15 refs
(BM-RI-6251)

The heats of formation of gehlenite and talc were determined by hydrofluoric acid solution calorimetry. The results are reported in terms of the constituent oxides ($\Delta H_{298.15}$ = −31.1 ±0.5 kcal/mole for gehlenite and $\Delta H_{298.15}$ = −44.9 ±0.3 kcal/mole for talc) and in terms of the constituent elements ($\Delta H_{298.15}$ = −952.8 ±0.7 kcal/mole for gehlenite and $\Delta H_{298.15}$ = −1,415.5 ±1.4 kcal/mole for talc). Author

N63-17459 Atomic Energy Commission. New York Operations Office. Health and Safety Lab., N.Y.
DETERMINATION OF BERYLLIUM IN URINE BY ION EXCHANGE SEPARATION AND FLUORIMETRIC MEASUREMENT
Doris C. Sutton Washington, AEC Div. of Tech. Inform., Feb. 1963 22 p 14 refs
(HASL-134) OTS: $0.50

A method is reported for the determination of beryllium in one-liter urine samples. Using aluminum as carrier, beryllium is collected as the phosphate. (Ethylenedinitriolo) tetrasodium-acetate (EDTA) is used as masking agent for interfering cations. Aluminum and beryllium are complexed as fluorides with sodium fluoride and are exchanged on the hydroxide form of Dowex 1 X−4 anion resin. Calcium, magnesium, iron, and phosphate are not exchanged. The fluoride complexes are removed from the resin by eluting with 6N hydrochloric acid. The eluate is wet ashed with nitric and sulfuric acids, and beryllium and aluminum are collected as hydroxides. Chemical recovery is determined by gamma counting Be-7 tracer. The normal beryllium is measured fluorimetrically with morin as the reagent. The overall chemical recovery observed with eight experimental one-liter samples was 93.5 ±4.5 percent. The lower limit of detection for the fluorimetric measurement is 0.005 μg per tube, which is equivalent in the overall method to 0.05 μg per liter of urine. Author

N63-17461 United Nuclear Corp. Development Div., White Plains, N.Y.
THE DEVELOPMENT OF URANIUM CARBIDE AS A NUCLEAR FUEL Third Annual Report, Sept. 1, 1961 to Oct. 31, 1962
J. Crane, H. S. Kalish, and F. B. Litton Washington, AEC Div. of Tech. Inform. Jan. 15, 1963 53 p 3 refs
(Contract AT(30-1)-2374)
(UNC-5048) OTS: $1.25

Tests programs were carried out to determine the effect of carbon content and method of fabrication (powder metallurgy and casting) on irradiation stability, thermal expansion, thermal conductivity, and hot hardness of uranium carbide. Preparing of the test specimen and the carrying out of the test program is reported. Out-of-pile compatibility tests of the materials system used for the irradiation test program and exposure tests of cast uranium carbide are described. N.E.A.

N63-17475 Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.
THE MICROWAVE SPECTRA, STRUCTURE AND DIPOLE MOMENT OF "cis" N_2F_2
Robert L. Kuczkowski and E. Bright Wilson, Jr. [1962] 21 p 17 refs Presented at the Symp. on Molecular Structure, Columbus, Ohio, June 1962

The microwave spectrum of one isomer of $F^{14}N^{14}NF$ and $F^{15}N^{14}NF$ is reported and from this the structure is derived as planar and "cis" with the following structural parameters: d(NN) = 1.214 ±0.005A, d(NF) = 1.384 ±0.01A <FNN = 114.5° ±0.5°. A dipole moment of 0.18 ±0.01D has been evaluated from the rotational Stark effect. Transitions of the molecule in an excited vibrational state are reported. From relative intensity measurements of this state, a vibrational frequency of 300 ±35 cm^{-1} is estimated. A method is demonstrated enabling the ratio of nuclear spin statistical weights of two levels to be determined from the growth rate of their intensity with increasing Stark modulation voltage. Author

N63-17476 Hanford Atomic Products Operation, Richland, Wash.
THE DEVELOPMENT OF A DRAWING LUBRICANT
Frank B. Quinlan June 4, 1963 10 p
(Contract AT(45-1)-1350)
(HW-77291) OTS: $0.50

A high melting, asphalt lubricant for metal forming has been developed. With or without a superficial coating of another lubricant, it can be used to protect exotic metals from scoring during a cold-forming operation. Unlike conversion coats (oxides, fluorides, and phosphates) the first coat of this lubricant is very thin, as well as inexpensive to apply and to remove. In some cases, the initial application of the lubricant will last through several deforming operations, such as successive wire drawing reductions or tube sinking passes. Author

N63-17479 Naval Research Lab., Washington, D.C.
THE BEHAVIOR OF MONOLAYERS OF PROGRESSIVELY FLUORINATED FATTY ACIDS ADSORBED ON WATER
Marianne K. Bernett and W. A. Zisman May 21, 1963 15 p 20 refs
(NRL-5932)

A study has been made on the force-area, surface potential-area, and surface moment-area relations of monolayers of two series of progressively fluorinated fatty acids spread on water at various pH values. The series were n-heptadecanoic acids with substitutions in the 17-position of perfluoromethyl, perfluoropropyl, perfluoropentyl, and perfluoroheptyl groups, and n-undecanoic acids with substitutions in the 11-position of perfluoroheptyl, perfluorooctyl, and perfluorodecyl groups. In both series the stability of the monolayers at all pH values falls off rapidly with progressively shorter perfluoro segments. The compressed films of all stable acids are in the liquid-condensed state, indicating limiting areas per molecule of $36A^2$ to $38A^2$. The change in surface potentials of all films is larger than those of any aliphatic acid, and shows that the dipole is oriented in the opposite direction. By use of the Helmholtz equation, the vertical components of the apparent dipole moment were ascertained from the potentials and it was possible to compute, under a given set of conditions, the values of the vertical component of the partially fluorinated chain only. The results were interpreted in terms of orientation and packing of the adsorbed molecules, steric hindrance due to the bulky perfluoro segments, and electrostatic repulsion. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-17051 Hawker Siddeley Aviation Ltd. Astronautics Group (Gt. Brit.)
SPACE COMMUNICATIONS
S. R. Dauncey *In* Advisory Group for Aeronautical Research and Development, Paris (France) Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961 [1961] p 65–67 (See N63-17048 15-01)

The major problem areas of long-range data communication and scientific space-probe transmission are discussed, including: the lifetimes and efficiencies of solid-state and thermionic components; the effects of radiation on semiconductors; the development of suitable power sources; the effects

of space environment on electronic components; the stabilization of signal symmetry; the behavior of machine parts in a vacuum; and the modulation of radio and coding techniques. D.E.R.

N63-17053 International Astronautical Federation, Paris (France)
SPACE COMMUNICATIONS – FRAMING THE WINDOW
Andrew G. Haley *In* Advisory Group for Aeronautical Research and Development, Paris (France) Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961 [1961] p 77–90 (See N63-17048 15-01)

Radio space communications are classified as to their type and function, and each is discussed. The types are: (1) radio communications between the earth and artifacts in space; (2) the maintenance of "windows" on earth for the reception of radio signals from space; and (3) the use of artifacts in space to relay communications to earth. The problems of space communication are discussed and the conclusions are that: (1) no serious interference problems exist on a regional level that cannot be solved on a regional basis; (2) the development of new launching phase techniques may be inhibited by premature adoption of preferred system characteristics; and (3) launching facilities are, and will be, so limited in number as to preclude the necessity for coordinating their normal radio activities on an international basis. D.E.R.

N63-17086 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ANTENNA SIDE LOBE REDUCTION: AN ANNOTATED BIBLIOGRAPHY [1958-MAY 1962]
George R. Evans, comp. May 1962 97 p 189 refs
(Contract AF 04(647)-788)
(Rept. 3-77-62-13; SB-62-17)

One of the important aspects of antenna design is to obtain the desired width of the main beam while suppressing unwanted side lobes. Design information of various types of antennas is included in this compilation, along with radiation-pattern analysis. Author

N63-17162 Michigan U., Ann Arbor
SINGULAR GAUSSIAN MEASURES IN DETECTION THEORY
William L. Root and M. Rosenblatt, ed. Repr. of Chapter 20 from book "Time Series Analysis", John Wiley & Sons, Inc., N. Y., 1963 p 292–315 23 refs
(NASA Grant NsG-2-59)

The validity of using a Gaussian model in singular signal detection problems is treated by finding the particular Gaussian measures on function spaces. Results are applied to the detection theory, and proofs are given for some of the propositions. D.E.R.

N63-17285 Raytheon Co., Wayland, Mass.
MTBF APPORTIONMENT IN RELIABILITY CONTROL OF THE MAULER DESIGN
Leonard R. Doyon *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif, 18–21 June 1962 [1962] p 251–263 5 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper describes the technique used by reliability engineers in apportioning the MAULER Acquisition and Track-Illuminator radar-subsystems MTBF (mean-time-between-failure) design requirements down four levels to the subassemblies. It is shown how the MTBF apportioned values, when made specific design requirements enforced by MAULER Systems management policies and key reliability procedures, evolved into an effective tool for controlling the reliability of the MAULER radar-subsystems design. Author

N63-17336 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
RADIO AND OPTICAL SPACE COMMUNICATIONS
R. D. Potter, R. Stevens, and W. H. Wells Oct. 30, 1962 22 p 38 refs Presented at the Sixth Meeting of the AGARD Avionics Panel, Paris, July 6–12, 1962
(NASA Contract NAS7-100)
(NASA-CR-50062; JPL-TM-33-85) OTS: $2.60 ph, $0.86 mf

The theory and state-of-the-art of laser sources is reviewed, with the possible application of these devices to space communications and long-range radar (or lidar). Sample optical and radio-frequency systems are analyzed in detail. Practical system and component problems which arise in optical communication and lidar systems are discussed. Author

N63-17380 Hughes Aircraft Co., Culver City, Calif.
SPATIAL FREQUENCY CHARACTERISTICS OF FINITE APERTURE ANTENNAS Scientific Report No. 1
A. Ksienski July 1962 28 p 5 refs
(AFCRL-62-975)

The imaging properties of finite aperture antennas are considered from the spatial frequency point of view. It is shown that the spectral frequency bandwidth of a finite aperture antenna is theoretically unlimited. Practically, the information available is limited by processing noise and errors, and these limits are quantitatively evaluated for several arrays. Methods are presented for the retrieval of the information which is in excess of the conventionally accepted information limit. Author

N63-17424 Lincoln Lab., Mass. Inst. of Tech., Lexington
OPTIMUM SATELLITE DISPENSING VELOCITIES FOR AN EQUATORIAL HIGH ALTITUDE NONSYNCHRONIZED SATELLITE COMMUNICATION SYSTEM
W. E. Morrow, Jr. Dec. 5, 1962 7 p
(Contract AF 19(628)-500)
(Rept. 36 G-3)

Continuous availability up to 1000 days from launch can be achieved with a high-altitude (20,000 miles) equatorial communication-satellite system, with only 20 satellites launched from a single launch vehicle, when proper dispensing velocities are employed. Author

N63-17449 Weapons Research Establishment (Australia)
POWER SPECTRA AND THEIR ESTIMATION, WITH PARTICULAR REFERENCE TO DISCRETE TIME SERIES HAVING AN UNKNOWN TREND
H. H. Evans Feb. 1963 35 p 15 refs
(Tech. Note SAD-110)

Methods of determining the power spectrum of a time series are quoted, and a technique is evolved for estimating the spectrum of noise superimposed on an imperfectly known trend. The effects of trend removal and the use of different spectrum smoothing devices are discussed and illustrated, both for artificial and real-time series. Several estimates of the spectrum of the noise of the FPS 16 radars in use at Woomera are included. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-17035 Stanford U., Calif.
A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL THROUGH TIME SHARING OF MIXED INPUTS
B. Brentnall and W. H. Horton Feb. 1963 39 p
(Grant AF-AFOSR 138-63)
(SUDAER-147)

This paper presents a design for an inexpensive, mobile, accurate, broad-spectrum data-acquisition system with digital readout and control capability. It will accept the outputs from a wide range of common transducers, scan them at a rate up to 5 per second, and process them to an overall accuracy of at least 99.43%. Author

N63-17062 Watkins-Johnson Co., Palo Alto, Calif.
APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION—ADDENDUM Interim Engineering Report No. 3, 1 Jan. through 31 Mar. 1963
S. E. Sobottka [1963] 13 p 2 refs
(Contract AF 33(657)-8917)
(W-J 63-610R12-1)

The relative advantages of convergent flow gun and linear flow gun traveling-wave phototubes are discussed in order to clarify those situations in which the former excels. Convergent flow guns are preferable in the following two situations, where it is assumed that the light signal is collected and focused onto the photocathode by a telescope of some kind: (1) The light source is not a point and the image is larger than the photocathode. In this case, the receiver sensitivity is proportional to the cathode area. (2) The light source is effectively a point, e.g., a laser source. In this case, the image may be smaller than the cathode, but the larger the photocathode, the less directional is the receiver—an important consideration when the source and receiver cannot be perfectly aligned, and atmospheric effects cause virtual motion of the source. Satellite telemetry, and laser range-finding systems are typical examples of this situation. The effect of the acceleration region on the beam modulation is discussed by utilizing the results from low-noise TWT theory. Author

N63-17064 Weapons Research Establishment (Australia)
SEMICONDUCTOR SAMPLE AND HOLD CIRCUITS Technical Note
D. H. Rodgers Feb. 1963 33 p 4 refs
(EID-61)

Where digital conversion of a cyclically varying analog signal is to be performed, the analog signal must be accurately sampled at the desired point in the cycle, and then held while a digital conversion takes place. In the W.R.E. automatic data-processing system, a circuit to perform these functions is required with the following specification: sample time, 15 μsec; hold time, 50 μsec; aperture time, <.1 μsec; accuracy, 0.1% of 10 v. The design and development of a sample and hold circuit which meets this specification is discussed. Quantitative relationships are also derived which assist in designing such circuits to required speed and accuracy limits. Author

N63-17079 Harry Diamond Labs., Washington, D.C.
A MICROMINIATURE AMPLIFIER WITH THIN-FILM PASSIVE PARTS
B. Mermelstein and W. C. Boesman Apr. 26, 1963 24 p 10 refs
(TR-1119)

A microminiature 30-mc IF amplifier stage was fabricated from vacuum-deposited thin-film passive components and two inserted parts. The vacuum-deposited parts, thin films of nickel chromium, aluminum, and silicon monoxide, were laid down for use as resistors, conductors, and dielectrics, respectively. In the deposition processes, dimensionally accurate masks are essential, and they were achieved by the use of a spark-erosion technique. A specially designed mask-and-substrate holder accurately indexed the masks relative to the substrates. This amplifier represents the first HDL operating device to employ vacuum-deposited conductors, resistors, and capacitors. Author

N63-17085 General Electric Co. Research Lab., Schenectady, N.Y.
OPTIMUM DESIGN OF CYLINDRICAL ELECTRON BOMBARDMENT HEATERS Scientific Report No.4
J. M. Houston, T. A. Howlett, and H. F. Webster May 1963 9 p
(Contract AF 19(604)-8424)
(AFCRL-63-453)

It is shown that an optimum geometry exists for a cylindrical electron-bombardment heater, in which maximum thermal flux is to be delivered with stable operation and long life of the bombardment heater coil. The procedure for finding the stable operating condition is illustrated, and the optimum heater size is evaluated. Author

N63-17140 Stanford U., Calif.
ENHANCED ULTRAVIOLET OUTPUT FROM DOUBLE-PULSED FLASH LAMPS
J. L. Emmett and A. L. Schawlow [1963] 12 p 1 ref Submitted for Publication
(NASA Grant NsG-331-63)
(NASA CR-50175) OTS: $1.60 ph, $0.80 mf

Measurements of the spectral output as a function of current density of the high peak light intensity from commercial xenon flash lamps are reported. The spectral output of the flash tube for two different current densities is given. The peak intensity is graphically plotted as a function of current density for various wavelengths. The ratio of integrated (in time) light output of double pulse to a single long pulse of equal total energy as a function of wavelength is discussed. Several applications of the double pulse technique are presented. N.E.A.

N63-17174 Illinois U., Urbana
PHOTODIODE AS A SENSITIVE TEMPERATURE PROBE Technical Report
R. C. Dimick and G. J. Trezek Charlottesville, Va. U., School of Engineering and Applied Sci. Apr. 1963 17 p 4 refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(111-8-P)

A temperature probe capable of reading temperature deviations of 0.005° F, or less, at ambient temperatures has been developed, using the large temperature coefficient of the reverse current of a Sylvania 1N77B photodiode. The photodiode case, a .072 inch-dia. × .80 inch-long glass cylinder, makes possible a small but very rugged probe assembly. Author

N63-17260 ARINC Research Corp., Washington, D.C.
FAILURE RATES AND FAILURE MODES OF AIRBORNE ROTARY DEVICES, RELAYS, AND OTHER ELECTRICAL PARTS Special Report
J. M. Evans Dec. 31, 1962 100 p
(Contract AF 33(657)-7382)
(Publ. 204-1-336)

Failure rates and failure-mode distributions were determined for the following electrical parts employed in airborne equipments: small rotary devices (a.c., d.c., and servomotors; motor generators; resolvers; synchrotransmitters; differential generators; transformers; and repeaters), relays, electrical connectors (plugs and jacks), crystals (frequency-control), and certain semiconductor devices (diodes and transistors). Author

N63-17279 Minneapolis-Honeywell Regulator Co. Aeronautical Div., Minn.
REDUNDANT ADAPTIVE FLIGHT CONTROL SYSTEMS AS USED IN SPACE VEHICLES
John N. Mitchell and Allyn J. Forsman *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 147–156 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The reliability of present flight-control systems is reviewed and the need for stability augmentation systems is emphasized. Experience with the X-15 aircraft has shown that it is beyond a human pilot's capabilities to control a vehicle's path and attitude on launch and reentry trajectories. However, the reliability of automatic control systems is inadequate at present to meet the requirements of space flight. The dual redundant, or adaptive redundant, control system used on the X-15 can be adapted for other space vehicles if the configuration design is changed to eliminate the low, fixed-gain mode. So, the ultrareliability required of space-vehicle control systems can be obtained by modification of existing systems, frequent inspections, and providing a number of spare circuits. D.E.R.

N63-17281 Radio Corp. of America, Camden, N.J.
REDUNDANCY AS APPLIED TO ANALOG CIRCUITRY FOR PROJECT RELAY
Raymond A. Smith (RCA, Astro-Electron. Div.) and Edgar L. Bolden *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 179–198 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The use of redundancy in analog circuitry should be carefully weighed to determine the suitability of the level of application within a system. Criterias dictating this level are circuit unreliability, circuit criticality to system's operation, weight, space, and cost. The use of redundancy standby operating will result in larger net gains in reliability over the standby inoperative technique when automatic switching of the latter is required. When earth-controlled switching is provided, the latter technique is desirable, especially at the function level. The incorporation of redundancy in Project Relay results in a predicted reliability of .9508, increasing the reliability by a factor of 1.5 over that of a nonredundant system. Author

N63-17287 International Business Machines Corp. Space Guidance Center Owego, N.Y.
EXPERIMENTAL EVALUATION OF PREDICTIONS OF PROBABLE CIRCUIT PERFORMANCE
Malcolm A. Young *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 285–296 7 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The results obtained when six digital-computer switching circuits were analyzed for probable performance at 2000 hours' life, compared with measured performance at about the same age based on a controlled life test of circuit samples, are presented. Three methods of performance prediction are used: the combination method, the Monte Carlo method (synthetic sampling), and regression analysis. Estimates of the circuit distribution functions are made and are found to be accurate estimates of the circuit output parameters. The advantages of each of the three systems of circuit analysis in the review of a circuit design during synthesis are pointed out. D.E.R.

N63-17298 Republic Aviation Corp., Farmingdale, N.Y.
RELIABILITY IN PROCUREMENT ON F-105 AIRCRAFT ELECTRONIC SYSTEMS
Arthur P. Coletta, Joseph A. Cravero and Charles W. Russell *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 423–439 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

A reliability technique is applied to an existing production program. This technique justifies the cost of reliability improvement by expressing the resulting benefits in terms of monetary values; it also studies the sensitivity of estimated savings to variations in the reliability assumptions. The only sure savings to be accrued by a retrofit reliability program are a reduction of manpower requirements, replacement parts, and spare parts. But maximum benefit is obtained from an early investment in reliability, which increase initial cost, but is an investment with guaranteed return. D.E.R.

N63-17351 Office of Naval Research, Washington, D.C.
PROCEEDINGS OF SECOND CONFERENCE ON THE NAVY MICROELECTRONICS PROGRAM, WASHINGTON, D.C., SEPTEMBER 24-26, 1962
[1963] 366 p 37 refs
(Sponsored by ONR and NRL)
(ONR-14) OTS: $5.00

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23. MICROELECTRONICS RESEARCH PROGRAM FOR INFORMATION PROCESSING IN THE OFFICE OF NAVAL RESEARCH R. H. Wilcox (ONR) p 330–332 (See N63-17374 15-09)
24. MICROELECTRONICS PROGRAM AND PLANS IN THE BUREAU OF SHIPS G. W. Neumann (Bureau of Ships) p 333–339 (See N63-17375 15-09)
25. A THIN FILM ELECTRONIC SUBSYSTEM FOR MISSILE APPLICATIONS S. H. Gordon (APL) p 340–346 (See N63-17376 15-09)
26. EFFECTS OF NUCLEAR RADIATION ON ELECTRONIC EQUIPMENT T. D. Hanscome (Hughes Aircraft Co.) p 347–354 (See N63-17377 15-23)

N63-17355 Naval Ordnance Lab., White Oak, Md.
MICROELECTRONICS PROGRES REPORT
H. W. Mc Kee and R. E. Grantham *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 34–53 (See N63-17351 15-09) OTS: $5.00

This report covers the following: thin semiconductor films; field effect modulation; magnetic film logic; the correlation detector; and RF insensitive switch development. J.R.C.

N63-17356 Naval Ordnance Lab., Corona, Calif.
MICROWAVE SEMICONDUCTOR MICROELECTRONICS
Robert W. Yancey *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 54–57 (See N63-17351 15-09) OTS: $5.00

A study has been initiated to develop and determine the properties of microwave functional circuits employing the advanced concepts of microelectronics and the best available semiconductor devices. Of particular emphasis during the initial period has been the application of the tunnel diode as an active microwave device. To date, L- and X-band oscillators, an X-band autodyne converter, and an L-band mixer–oscillator have been constructed, using the microelectronics approach and tunnel diodes, with very encouraging results. All of these circuits were constructed in and on double-clad Rexolite, using thick film and "pill" type components. J.R.C.

N63-17357 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
THE MICROELECTRONICS LABORATORY AT JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY
William Liben *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 60–76 (See N63-17351 15-09) OTS: $5.00

Proposed effort in microelectronics is divided into three areas of interest: (1) research on components devices, materials, and procedures; (2) fabrication of prototype systems for use in laboratory systems; and (3) work with vendors and laboratory system designers in procuring microelectronic hardware. All of the methods proposed for the fabrication of microelectronic circuits are based upon the manipulation of semiconductors to produce electronic circuits and the use of thin films of dielectric and conductive materials to fabricate a complete electronic circuit. A method of assembling the solid circuit package has been developed which meets the following requirements: (1) the maximum possible packaging density consistent with reasonable unit volume power dissipation; (2) Navy recommendations for microelectronic packaging as set forth in the proposed guide for Microelectronic Standards; (3) a relative ease of fabrication consistent with mechanical strength; (4) ease of interconnection determination, layout, and realization; and (5) no bending or twisting of semiconductor element leads and a minimum stress and strain on element leads during and after packaging. J.R.C.

N63-17358 Naval Research Lab., Washington, D.C.
NRL CONTRIBUTIONS TO THE MICROELECTRONICS PROGRAM
C. V. Parker *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 77–86 (See N63-17351 15-09) OTS: $5.00

This report on microelectronics includes a discussion of the following: instrumentation; tunnel diode fabrication; thin-film studies; P-N junction theories and experiments; and nuclear radiation effects. J.R.C.

N63-17359 Naval Material Lab., Brooklyn, N.Y.
MICROELECTRONICS FOR GENERAL SHIPBOARD USAGE
G. C. Neuschaefer *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 89–92 (See N63-17351 15-09) OTS: $5.00

This report on the adaptation of microelectronics to general shipboard electronics covers the following: the availability of analog circuitry in microminiature form; the standardization of module function; the module configuration standardization; the maintainability of modularized equipment; and the effectiveness of function standardization. J.R.C.

N63-17360 Navy Electronics Lab., San Diego, Calif.
THE MICROELECTRONICS PROGRAM AT NEL – A PROGRESS REPORT
W. P. Mitchell *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 93–108 (See N63-17351 15-09) OTS: $5.00

This microelectronics report covers the following: the "P" time counter; the micromodule test set; the MOCC computer; microelectronic logic circuitry; and microelectronic packaging. J.R.C.

N63-17361 General Electric Co., Syracuse, N.Y.
PROGRESS IN THIN FILM COMPONENTS
H. W. Katz *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 121–133 (See N63-17351 15-09) OTS: $5.00
(Contract N62269-1335)

The development of linear circuits in microelectronic form is studied, using thin-film components. The development of these low-frequency linear circuits indicates the versatility of thin-film techniques in meeting the various requirements of circuit design. Further component development is still required in order to further improve the range of RC parameters and their stability under extended environmental conditions. Still needed are techniques which would improve the compatibility between thin films and all-semiconductor networks. J.R.C.

N63-17366 Radio Corp. of America, Princeton, N.J.
INSULATED-GATE FIELD-EFFECT DEVICES FOR MICROELECTRONICS
T. O. Stanley *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 199–205 7 refs (See N63-17351 15-09) OTS: $5.00
(Contracts AF 19(604)-8040 and AF 19(604)-8836)

The electrical parameters of an idealized insulated-gate field-effect transistor are given and possible microelectronic applications are discussed. These applications include cockpit displays, amplifiers, and logic circuits. A frequency divider fabricated with these transistors will occupy a volume of about one-half inch cubed and will dissipate less than two watts. R.C.M.

N63-17368 Stanford U., Calif.
SPECULATIVE RESEARCH IN MICROELECTRONICS AT STANFORD UNIVERSITY
John G. Linvill *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 219–229 5 refs (See N63-17351 15-09) OTS: $5.00

Speculative research in microelectronics is discussed as follows: redundancy, adaption, surface-field-effect transistor, and superconductive trapped flux memory. R.C.M.

N63-17371 United Aircraft Corp. Norden Div., Norwalk, Conn.
A 1.5 WATT MOLECULAR SERVO AMPLIFIER
M. W. Aarons *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 273–288 (See N63-17351 15-09) OTS: $5.00
(Contract NOw 61-1053-C)

A 1.5-watt crystal feedback amplifier for servo systems has been developed. Approximately six completed amplifiers are produced simultaneously per 3/4-in. wafer of single crystal silicon. Oxide-masked planar-diffusion techniques are employed throughout. Interconnections are of deposited aluminum. The device is a Class A, d.c. coupled a.c. differential amplifier. J.A.J.

N63-17372 Motorola, Inc. Semiconductor Products Div., Phoenix, Ariz.
A STATUS REPORT ON INTEGRATED CIRCUITS
C. L. Hogan *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 289–320 (See N63-17351 15-09) OTS: $5.00

The impact of microminiaturization on digital circuits and computer systems, the design of logic circuits, the impact of integrated circuits upon computer organization, and the interconnection problem are discussed and evaluated. J.A.J.

N63-17373 Office of Naval Research, Washington, D.C.
MICROELECTRONICS RESEARCH SPONSORED BY ONR
E. H. Hurlburt *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 325–329 (See N63-17351 15-09) OTS: $5.00

The contract program in microelectronics of the Electronics Branch of the Office of Naval Research is described. The possible directions of research described are: (1) general material research which has as a goal the discovery of new knowledge of the solid state of matter which can be formulated and applied in microelectronics; (2) seeking of new combinations and applications of old knowledge of solid-state physics to yield functional block microelectronic devices. An example of special avenues in planning research is the use of controlled and programed electron or ion beams to deposit exceedingly minute components in atomic or molecular layers from a plasma source. In bioelectronics, microelectronics provides instrumentation of minute size and delicate form by which the behavior, physiology, and nervous systems of animals and humans can be investigated. N.E.A.

N63-17374 Office of Naval Research, Washington, D.C.
MICROELECTRONICS RESEARCH PROGRAM FOR INFORMATION PROCESSING IN THE OFFICE OF NAVAL RESEARCH
Richard H. Wilcox *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 330–332 (See N63-17351 15-09) OTS: $5.00

The Information Systems Branch of the Office of Naval Research is concerned primarily with new or improved methods, devices, and techniques for processing information. It has no program in microelectronics but in an effort to improve information processing it supports a number of microelectronics

investigations. Supported are investigations of thin films, both magnetic and cryogenic, and of electron-beam activated microprocesses. An enumeration of the program task is given. Observations concerning the neglected areas of microelectronics are discussed. N.E.A.

N63-17375 Bureau of Ships, Washington, D.C.
MICROELECTRONICS PROGRAM AND PLANS IN THE BUREAU OF SHIPS
G. W. Neumann *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 333–339 (See N63-17351 15-09) OTS: $5.00

A brief summary of the work supported by the Bureau of Ships in developing microelectronic techniques and devices, and some of the areas in which these devices are applied is presented. A program for integrated shipboard electronics is presented (PRISE program) so as to achieve the coordination of general usage functional electronic systems, optimum application of advanced reliability and maintenance techniques, and the design of the ship's electronic systems. The advantages of such a system are: reduced time lead and development costs, improved system reliability, improved maintainability, and simplified logistics. D.E.R.

N63-17376 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
A THIN FILM ELECTRONIC SUBSYSTEM FOR MISSILE APPLICATIONS
S. H. Gordon *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 340–346 (See N63-17351 15-09) OTS: $5.00

An entire electronics subsystem (a large decoder providing two types of output functions) has been synthesized for military missiles, using thin-film techniques. The advantages to such a system are: thin-film circuit fabrication is more advanced and flexible for custom-made electronic systems; the speeds and pulse risetimes of thin-film circuitry are much higher than in bulk semiconductor circuits; the lead time to fabricate the system is shorter; the need for circuit redesign, necessary with bulk techniques, is eliminated; the use of large amounts of thin-film circuitry in electronic systems seems quite feasible. It has been found that: many companies can fabricate such subsystems; environmental conditions of operation present no problem and reliability appears to be quite good; the cost of such subsystems is comparable with the cost of equivalent welded systems; the size and weight of the thin-film systems are about one-third to one-fourth the size of the welded systems; the cost of the throwaway module can be kept to a reasonable value, around $250, without sacrificing quality or ease of handling. D.E.R.

N63-17378 Watkins-Johnson Co., Palo Alto, Calif.
[DEVELOPMENT OF A COUPLED-CAVITY TRAVELING-WAVE TUBE AMPLIFIER WHICH WILL PRODUCE 1000 CW AT 35 Gc] Sixth Monthly Progress Letter, May 1, 1963–May 31, 1963
K. W. Slocum June 10, 1963 4 p Prepared for Mass. Inst. of Tech.
(Contract AF 19(628)-500)
(W-J-63-615R6)

Progress is reported on research aimed at developing a coupled-cavity traveling-wave tube amplifier which will produce 1000 watts CW at 35 Gc. A description and the status of work performed on the first, second, and third experimental amplifiers are presented. N.E.A.

N63-17419 Varian Associates, Palo Alto, Calif.
HIGH POWER R-F WINDOW STUDY PROGRAM Quarterly Technical Note No. 3, Jan. 1 through Mar. 31, 1963
Floyd Johnson Apr. 1963 48 p 12 refs
(Contract AF 30(602)-2844)
(Varian Rept. 304-3Q; RADC-TDR-63-194)

A study was made into the possibilities of waveguide window synthesis by computer solution of a multiple complex matrice equation. In general, waveguide windows can be described in terms of shunt susceptances, lengths of waveguide (dielectric or air loaded), and dielectric interfaces. The T_{21} and T_{22} transmission parameters which form a part of the solution to such an equation can be used to minimize the reflection coefficient of a window. A 100 percent bubble-free fused quartz window was fabricated and tested in the ring resonator. This window became visibly red hot at 190 kilowatt cw, which is about twice the power level at which failure occurred in several previously tested windows made of a poorer grade of quartz. Another difference in this test was that the quartz itself did not deform. One single disc, zero-degree cut, synthetic-sapphire window assembly was completed. The broadbanding of half-wavelength block windows was examined, and a complete example of the process for a beryllium oxide window is demonstrated. Techniques for mode shifting and impedance matching are discussed. One sample of a BeO block window was tested, without failure, to 222 kilowatts cw in the ring resonator. Several half-wavelength block windows fabricated using AL300, AL399, and AL995 ceramics were tested to failure in the ring resonator. The failure in all cases is a vertical crack across the center of the face of the block and perpendicular to the broadwall. The power level at which these failures occurred was approximately 100 kilowatts.
Author

N63-17421 Federal Electric Corp. Engineering and Support Services Div., Paramus, N.J.
SYSTEM RELIABILITY PREDICTION BY FUNCTION Final Report
May 15, 1963 72 p refs
(Contract AF 30(602)-2687)
(RADC-TDR-63-146)

The purpose of this study was to develop techniques for predicting the reliability of electronic equipments and systems during the early planning stages. The correlation studies performed were categorized into three areas: radar, ground communication, and data processing. A number of applicable radar and ground communication systems were selected for study, and definite correlation was found between functional characteristics and actual field MTBF. The results of these correlation studies led to the development of prediction techniques for both the radar and ground communication categories. The basic approaches to the problem of isolating particular functional levels which can be correlated with the reliability of data-processing equipments are discussed. Author

N63-17448 Weapons Research Establishment (Australia)
RANGE OF VALIDITY FOR THE COHN SYNTHESIS OF WAVEGUIDE FILTERS
K. B. Whiting Mar. 1963 14 p 5 refs
(Tech. Note EID-66)

The efficiency of the Cohn Synthesis in the design of direct-coupled waveguide filters had been checked with the aid of the IBM-7090 computer. Results show the deterioration in the synthesized response as bandwidth increases for various specified values of the passband voltage standing-wave ratio.
Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-17128 Naval Ordnance Test Station, China Lake, Calif.
SUPERSONIC TRACKS [Report during period Jan.–May 1962]
Ivar E. Highberg and Lester G. Garman Sept. 1962 27 p
(NOTS-1938, Rev. 1; AD-295150)

This report includes a description of the tracks, sled structures, propulsion techniques, and instrumentation which are adaptable to weapon systems test programs that require close-in photographic and electronic instrumentation data in a captive-flight environment that closely approximates free-flight conditions. I.v.L.

N63-17195 Texas U. Electrical Engineering Research Lab., Austin
OPERATION AND PERFORMANCE OF THE CEDAR HILL METEOROLOGICAL TOWER FACILITY Final Report
W. S. Mitcham and J. R. Gerhardt Bedford Mass. Geophysics Research Directorate, Dec. 31, 1962 24 p 5 refs
(Contract AF 19(604)-5556)
(Rept. 4-07; AFCRL-63-202)

A survey is presented of the sensor and readout instrumentation associated with the Cedar Hill meteorological tower facility, together with an analysis of its performance during the first two years of operations. Factors giving rise to system errors such as those involved in analog-to-digital conversion, digital code conversion, integrator drift, input scaling, and sensor malfunctioning are discussed, and tabulations are presented for their frequency distributions. Procedures are given for the detection of these errors and for the modifications which have been and will be made for their correction or reduction. Author

N63-17234 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
WIND INSTRUMENTATION RESEARCH FACILITY AT WHITE SANDS MISSILE RANGE
Roy I. Glass, Jr. and James A. Martin May 1963 18 p 3 refs
(ERDA-24)

The Wind Instrument Research Facility, a closed-circuit type of wind tunnel, has been installed recently at White Sands Missile Range. It is utilized for calibration of and research work on wind instrumentation. Salient features are wind speeds from 0.5 to 85 mph, with control capabilities of 0.1 mph increments in the low velocities, low turbulence levels in the 4×4×6 foot test section, and instrumentation including a Prandtl tube, a mean-velocity hot wire, and eddy-shed hot-wire wind-speed measuring devices, a yaw probe directional device, and a turbulence hot-wire system. Author

N63-17294 Bell Telephone Labs., Inc., Whippany, N.J.
CONFRONTING THE ENVIRONMENT
Thomas B. Delchamps *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 367–379 2 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper highlights two areas in the environmental field requiring a more imaginative and objective meeting of design and reliability functions. Thorough and timely environmental definition, as an essential ingredient of successful system design and meaningful reliability estimation, is discussed. Two examples of current importance in the areas of missile-vibration and space-environment simulation are briefly reviewed. Author

N63-17352 Naval Air Development Center, Johnsville, Pa.
MICROELECTRONIC APPLICATIONS PROGRAM
Howard B. Martin *In* Office of Naval Res., Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 8–13 (See N63-17351 15-09) OTS: $5.00

The Naval Air Development Center's microelectronic applications program has as its prime objectives the development of an in-house capability in microelectronic techniques and the application of microelectronics to systems, the review of proposed system applications of microelectronics, and the dissemination of information on microelectronics to BuWeps Avionics contractors and potential contractors. Action taken in the microelectronic applications program will be based on the following: (1) Electrical performance in compliance with the manufacturers' published data under a combination of load and temperature conditions; (2) conformance with the general requirements of Specification EL5-13; and (3) conformance with the reliability requirements of EL5-13. J.R.C.

N63-17362 Battelle Memorial Inst., Columbus, Ohio
THE PREFERRED MICROELECTRONIC FUNCTION PROGRAM
L. H. Stember, Jr. *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 Feb. 1963 p 134–140 (See N63-17351 15-09) OTS: $5.00
(Contract N62269-1717)

The preferred microelectronic function program has the following objectives: investigate methods of characterizing microelectronic functions; develop functional descriptions for selected high-usage functions; and make recommendations for R & D in microelectronic techniques. The intent of the program is to make the functional descriptions as general and as flexible as possible while retaining the desirable qualities of performance standards. This should allow the functions to be implemented by many different microelectronic techniques, yet give the system designers the advantages of readily available basic building blocks. J.R.C.

N63-17381 Atomic Energy Research Establishment, Harwell (Gt. Brit.)
A VACUUM FURNACE FOR SINTERING AT TEMPERATURES UP TO 2400° C
K. E. Francis and N. Hodge Jan. 1962 13 p 2 refs
(AERE-M-963) Available from HMSO: 3s

A resistance-heated furnace capable of sintering at 2400° C in a vacuum of 10^{-6} mm Hg is described. The furnace element consists of a combination of tantalum and tungsten, and gives a uniformly heated zone approximately 3 inches long by 3/4 inch diameter. Author

N63-17407 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EARTH ORBITING SPACE STATIONS
Edward H. Olling *In its* Manned Orbital Operations Spec. Section [1963] p 53–55 (See N63-17401 15-32)

The implications of orbiting space-station missions, the objectives of such vehicles, certain design configurations for the vehicles, and mission logistics and operations are discussed. Future space exploration will include: .establishing a manned

space station in orbit to conduct research and perform various vital space operations; establishing a manned lunar base to assist in lunar exploration and exploitation; and accomplishing manned planetary flights to explore the near planets, e.g., Mars and Venus. D.E.R.

N63-17408 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE STATIONS – CONFIGURATIONS AND DESIGN CONSIDERATIONS
Owen E. Maynard and Rene A. Berglund *In its* Manned Orbital Operations Spec. Section [1963] p 57–59 (See N63-17401 15-32)

The various space-station configurations proposed by NASA are reviewed and classified by mode of assembly—either earth assembled, orbital assembled but orbital erected; and by rotational characteristics—either nonrotating or rotating. Each of these configurations has its advantages, but each also has disadvantages, which are discussed. D.E.R.

N63-17413 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FACILITIES FOR MANNED SPACECRAFT DEVELOPMENT–MSC TEST FACILITIES
Joseph N. Kotanchik and H. Kurt Strass *In its* Manned Orbital Operations Spec. Section [1963] p 78–81 (See N63-17401 15-32)

The facilities of the manned spaceflight center for developing and operating suitable vehicles for manned use in space are described. Included are: the astronaut training facilities, the space environment simulator, the flight acceleration facility, the thermochemical test area, and the structures and materials laboratory, all of which constitute a valuable addition to the U.S. capabilities for successful execution of current and future space programs. D.E.R.

N63-17414 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SIMULATION AND TRAINING FACILITIES
Harold I. Johnson *In its* Manned Orbital Operations Spec. Section [1963] p 82–86 (See N63-17401 15-32)

The flight simulation and training facilities for the Apollo and Gemini projects are described and are found to serve the purpose of: (1) familiarizing the crew with the appearance and operational modes of all the instrument displays, switches, and control systems in the spacecraft; (2) acquainting the crew with many expected out-the-window views; (3) training the crew to detect and correct anticipated system failures; (4) acquainting the crew with the dynamic response characteristics of the spacecraft; and (5) familiarizing the crew with overall mission timing and allowing crew members to practice tasks in a specific flight plan. D.E.R.

N63-17415 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FLIGHT OPERATIONS FACILITIES
John D. Hodge and Tecwyn Roberts *In its* Manned Orbital Operations Spec. Section [1963] p 87–90 (See N63-17401 15-32)

The present picture of available and planned facilities for the operational support of manned spaceflight programs is presented, and the flexibility of future facilities to support various missions is emphasized. The design criteria for such a facility are: provision of a central control facility; use of existing facilities; continuous monitoring of the powered phase of the flight; a minimum of required voice, telemetry, and command at the time of retrofire for reentry; reentry tracking where feasible; and a high degree of reliability provided by the equipment selection, redundancy, and diversification of communication links. D.E.R.

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-16983 Pennsylvania State U. Ordnance Research Lab., University Park
REAL FLOW OVER A BODY OF REVOLUTION AT ANGLE OF ATTACK Technical Memorandum
E. J. Rodgers Mar. 28, 1963 175 p 26 refs
(Contract Nord-16597)
(Rept. TM-5.2420-13)

An investigation to determine the difference between the actual flow over a body of revolution and that predicted by the potential theory is reported. The solutions obtained contribute to the understanding of the real flow over a three-dimensional body of revolution, one of the major problems of fluid mechanics, and include data on pressure distributions, velocity, vorticity, and surface flows. D.E.R.

N63-16990 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE BREAKDOWN VOLTAGES OF SOME ELECTRONEGATIVE GASES AT LOW PRESSURES
Stefan Schreier Washington, NASA, June 1963 11 p 15 refs
(NASA TN-D-1761) OTS: $0.50

The breakdown voltages of five Freon gases and SF_6 were measured at low pressures between parallel plates to determine their insulating properties under these conditions, and especially to find their minimum breakdown voltages. It was found that the advantages of these gases over air are much less at low pressures than at atmospheric pressure or higher and that the use of these gases as insulators at low pressures is therefore limited. Preliminary investigations revealed, however, that the vapors of compounds that are liquid at normal temperature and pressure, such as FC-75, maintain their dielectric strength much better than do electronegative gases as the pressure is reduced, and thus seem to be promising for use as insulators at low pressures. Author

N63-17013 Office of Naval Research, Washington, D.C.
MATHEMATICAL METHODS FOR CALCULATING SHIP HULL FORMS OF DECREASED WAVE-MAKING RESISTANCE
S. W. W. Shor Jan. 1963 104 p 20 refs
(ONR-438)

The development of ship-hull forms of decreased wave-making resistance by mathematical methods has received some investigation in the past few years but little application. The theory and effectiveness of work done by other authors is reviewed. In addition, the mathematical machinery necessary to calculate hull forms by a method of steep descent is developed and applied to a simple example. The necessary resistance equations are formulated. A closed-form solution is

obtained for the smoothly varying portion of the wave-making resistance of an assemblage of sources and sinks traveling near the surface of the water. An integral for the interference terms which comprise the fluctuating portion of the wave-making resistance is also presented in the shape of a Laplace transform. It is concluded that much more extensive use may be made of mathematical methods to improve hull forms than has been the case heretofore. Author

N63-17020 Massachusetts Inst. of Tech., Cambridge
LINEARIZED THEORY FOR UNSTEADY TRANSONIC FLOW
Marten T. Lahdahl Mar. 1963 69 p 18 refs Presented at the Symposium Transsonicum, Aachen, Germany, Sept. 3–7, 1962
(Grant AF-AFOSR-156-63)
(MIT Fluid Dyn. Res. Lab. Rept. 63-2)

The present study of unsteady transonic flow was based on the use of a method of outer and inner expansions to obtain an asymptotic expansion of the disturbance velocities in powers of the parameter e/k, where e is a measure of the difference between the actual velocity in the mean steady flow and the local speed of sound. This parameter represents essentially the ratio of the wavelength of receding slow-moving waves to some typical length of the wing or body considered. Small steady or unsteady perturbations in transonic flow are discussed. The limiting case of steady flow is considered. An analysis of the effect of the receding waves is given. Zeroth-order solutions for three-dimensional wings were studied in detail. N.E.A.

N63-17029 Lockheed Missiles and Space Co., Sunnyvale, Calif.
TRANSITION FROM LAMINAR TO TURBULENT FLOW AT HYPERSONIC SPEEDS: AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano, comp. Dec. 1962 25 p 52 refs
(SB-62-55)

Experimental data on transition from laminar to turbulent flow at hypersonic speeds are by no means complete; nor does there exist a unified analytical theory to account for all aspects of this phenomenon. This bibliography represents an attempt to bring together significant reports on work in this area. The period searched was from 1947 to August 1962. Author

N63-17099 Drexel Inst. of Tech., Philadelphia, Pa.
A STUDY OF THE BREAK-UP OF SHAPED CHARGE JETS
Pie Chi Chou, Harbans S. Sidhu, and Richard W. Mortimer Apr. 1963 42 p 13 refs
(Contract DA-36-034-ORD-3672 RD)
(DIT-125-4)

Several possible explanations of the mechanism of the breakup of shaped charge jets are suggested. In particular, an approach using the assumption of viscoplastic flow is presented in detail. According to this approach, a constant area jet with linear velocity gradient breaks first at the tip, and then the breakup progresses back toward the rear. The average length of the fragments could be adjusted to two percent of the original jet length if a coefficient of viscosity of 100 lb.-sec./ft.^{2} were used. Author

N63-17125 Southwest Research Inst., San Antonio, Tex.
STUDIES OF LIQUID DYNAMICS IN ROCKET PROPELLANT TANKS Final Report [28 March 1960-31 May 1963]
H. Norman Abramson May 15, 1963 15 p refs
(NASA Contract NASw-146)
(NASA-CR-50258) OTS: $1.60 ph, $0.82 mf

Summaries of published papers and a listing of related technical reports are presented on liquid dynamics in rocket propellant tanks. Emphasis is placed on the essential role of nonlinear liquid dynamic behavior and on the complex nature of the liquid-structure interaction problem inherent in the design and construction of launch vehicles. I.v.L.

N63-17135 National Bureau of Standards, Boulder, Colo.
MELTING PRESSURE EQUATION FOR THE HYDROGENS
R. D. Goodwin Repr. from Cryogenics, v. 2, no. 6, Dec. 1962 p 1–39 9 refs
(NASA Order R-45)
(R-271)

The melting pressure of normal hydrogen, deuterium, and tritium are calculated from the equation $y = A \exp(-\alpha/T) + BT + C$, which describes behavior of the experimental function $y \equiv (P - P_t)(T - T_t)$, where subscript t refers to the triple point. For *para*-hydrogen, C = 0. The value B = 2/3 atm/deg^2 was estimated from the behavior of normal hydrogen at high temperature. Values of the constants, A = 30.3312 atm/deg and α = 5.693° K, were determined from two accurate new melting pressures of *para*-hydrogen at 16° and 22° K obtained with a compressibility apparatus. In the calculations, the parameter C is characteristic of individual substances if the values of A, α, and B are retained. N.E.A.

N63-17158 National Bureau of Standards, Washington, D.C.
PRESSURE-DENSITY-TEMPERATURE RELATIONS OF FLUID PARA HYDROGEN FROM 15 TO 100° K AT PRESSURES TO 350 ATMOSPHERES
Robert D. Goodwin, Dwain E. Diller, Hans M. Roder, and Lloyd A. Weber Repr. from J. of Res. of the National Bureau of Standards–A. Physics and Chemistry, v. 67A, no. 2, Mar.–Apr. 1963 p 173–192 22 refs
(NASA Order R-45)
(NASA-CR-50184; R-276; Paper 67A2-204)

Experimental data are presented at closely spaced intervals of temperature and density. The range of experimental densities is from 0.064 to 2.8 times the critical density. There are presented, in addition, tables interpolated uniformly in density and temperature and also in pressure and temperature arguments. Author

N63-17173 Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
AXIAL FIELD EFFECTS IN A MAGNETICALLY DRIVEN SHOCK TUBE
William H. Heiser May 29, 1963 57 p 15 refs
(Contract DA-36-039-SC-78108; DA-SIG-36-039-61-G14; and NSF Grant G-24073)
(MIT-TR-408)

The effects of a uniform magnetic field normal to the shock front upon shock states and expansion wave properties are theoretically and experimentally investigated for large magnetic-drive fields. One-dimensional theory and several simplifying assumptions are employed to predict the important effects, and a simple method of visualizing the possible shock states is obtained. The restrictions upon shock-wave formation imposed by various types of instabilities are considered. A series of experiments has been performed in a magnetically driven shock tube of annular cross section under conditions approaching the assumptions. Some difficulty was encountered in producing well-formed shocks, and a tentative link with the drive-current breakdown characteristics is established. Observations of well-formed shocks indicate close agreement with shock-transition theory, even when the axial magnetic field exceeds the switch-on value, although the expansion wave properties exhibit large departures from the theory. Some estimates of flow adjustments caused by radius effects and leakage through the boundary layer have been made, and are found to contribute to an understanding of the experimental results. Author

N63-17180 Avco Corp. Research and Advanced Development Div. Wilmington, Mass.

HYPERSONIC LAMINAR WAKES AND TRANSITION STUDIES (TASK 3.1 AND 3.5– REST PROJECT)

A. J. Pallone, J. I. Erdos, J. Eckerman, and W. Mc Kay June 14, 1963 55 p 21 refs

(Contract AF 04(694)-239)

(RAD-TM-63-33)

Results of theoretical and experimental investigations of the flow in the wake of slender hypersonic vehicles are presented. Nonsimilar solutions of the equations governing the "far wake" are obtained and contrasted with similar solutions and with solutions involving the Karman-Pohlhausen approach. Several numerical examples of the flow field in the wake generated by ballistic range models and by flight vehicles are presented. A series of ballistic range experiments with conical models of 10, 15, and 27-1/2-degree half-angles are described. The model velocity ranges between 4,000 and 17,000 ft/sec with range pressures varying from 15 to 380 mm of Hg in air. The experimental data are discussed in detail and the analysis is used to compute and correlate appropriate transition parameters. Based on the correlation, transition in the wake of a 5-foot 12-degree half-angle cone at 22,000 ft/sec is predicted to occur at approximately 20, 100, and 250 feet from the apex of the cone at altitudes of 100,000, 150,000 and 200,000 feet respectively. Author

N63-17188 Avco-Everett Research Lab., Everett, Mass.

STUDIES OF FLUID MECHANICS USING A LARGE, COMBUSTION DRIVEN MHD GENERATOR

J. F. Louis, J. Lothrop, and T. R. Brogan Mar. 1963 53 p 9 refs

(Avco-Everett Res. Rept. 145)

Results of a study of the fluid mechanics of MHD generators carried out at Avco-Everett Research Laboratory are analyzed. A large, combustion driven MHD generator (the Mark II) was built with the objective of gaining the detailed knowledge required for the prediction of performance of MHD generators. Outputs as high as 1480 kilowatts have been achieved with the generator. Author

N63-17210 Northrop Corp. Northrop Space Labs., Hawthorne, Calif.

LINEAR APPROACHES TO THE DYNAMICS OF FLUIDS SUBJECTED TO TIME VARYING BODY FORCES [Final Report, Apr. 1962–Mar. 1963]

B. W. Randolph Apr. 1963 47 p 3 refs

(NASA Contract NASr-23)

(NSL-63-21) OTS: $4.60 ph, $1.61 mf

The linear approach is used to treat the theory of fluids at zero gravity conditions. Emphasis is placed on very short time intervals after the onset of zero-gravity conditions. The theoretical work reported shows that linearized approaches to the dynamics of fluids for which gravitational body forces suddenly vanish fail to provide useful information and that the concept of incipient dynamics should be discontinued. N.E.A.

N63-17331 Aerospace Corp. Aerodynamics and Propulsion Research Lab., El Segundo, Calif.

NONEQUILIBRIUM ELECTRON TEMPERATURE EFFECTS IN WEAKLY IONIZED STAGNATION BOUNDARY LAYERS

Paul M. Chung and James F. Mullen May 20, 1963 71 p 26 refs

(Contract AF 04(695)-169)

(TDR-169(3230-12)TN-7; SSD-TDR-63-109)

An electron-energy equation is formulated for weakly ionized stagnation boundary layers (degree of ionization in the order of 0.1 percent or less) over highly cooled surfaces. Only the cases of moderately negative wall potential with respect to the plasma, where the ratio of the electron to ion-current densities is between about 10^{-1} to 10, are considered. The equation is simplified by taking advantage of the fact that the electron-energy equation is rather insensitive to the detailed variation of the electron-concentration profile. A solution of the simplified electron-energy equation is obtained analytically for the cases where the electron temperatures are not in equilibrium with the neutral gas temperatures. The effects of nonequilibrium electron temperatures on the electrical characteristics of the boundary layer are then analyzed. It was found that the equilibration process of the electron temperatures to the neutral gas temperatures is controlled by the ratio of the characteristic electron-energy conduction time to the characteristic temperature equilibration time. The characteristic residence time of electrons has been conventionally used instead of the conduction time. The ion current is found to be dependent on the electron temperature, but practically independent of the potential. Author

N63-17382 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

TRANSITION REVERSAL AND TOLLMIEN-SCHLICHTING INSTABILITY

Eli Reshotko Repr. from Phys. Fluids, v. 6, no. 3, Mar. 1963 p 335–342 32 refs

Recent theoretical developments in the stability of compressible boundary layers to Tollmien-Schlichting waves point out the importance of considering in the analysis the hitherto neglected temperature fluctuations and thermal boundary condition. Accordingly, the temperatures required for complete stabilization of flat-plate boundary layers to both two- and three-dimensional disturbances have been recomputed. The new required temperatures are all below the Dunn-Lin values. In the usual diagram of surface temperature vs. stream Mach number, there are two loops of complete stability. The trends suggested by this diagram tend to substantiate the experimentally observed transition-reversal phenomenon. The results are compared with available wind tunnel and flight data.

Author

N63-17432 Oklahoma U. Research Inst., Norman

ELECTRICALLY ENERGIZED SHOCK TUBES [Final Report]

Richard G. Fowler 1963 182 p 128 refs

(Contract Nonr-982(02))

(Tech. Rept. 19)

The nature and history of electrically driven shock waves; measurement equipment and diagnostic techniques; electrical behavior of gases in the driver discharge; electron driven plasma shock waves; breakdown waves, precursors, and electron fluid dynamics; radiation studies, interactions of shock waves; diffusion, and magnetic insulation in the electrical shock tube; shock-tube design; electrical properties of the flowing plasma; and miscellaneous observations are summarized in this report on fluid mechanics research. D.E.R.

N63-17457 General Dynamics/Astronautics, San Diego, Calif.

REFLECTED SHOCK WAVE MEASUREMENTS OF THE 2.7 MICRON CO_2 BAND BETWEEN 1200° K and 3000° K Technical Report

John C. Breeze and Carmine C. Ferriso May 1963 58 p 21 refs

(Contract Nonr-3902(00); Proj. Defender)

(GDA63-0240)

A shock-wave technique is described which provides a means of measuring the infrared integrated intensity of molecular bands at elevated temperatures. The total band emission from the high-temperature gas region existing between the end

plate of a shock tube and the reflected shock wave was measured using a rapid-response infrared detector. The total emission of the band is obtained as a function of path length as the reflected shock wave recedes from the end plate. The initial concentration, shock velocity, and reflected shock pressure were measured, and the final conditions of the test gas were calculated from the normal shock relations. The method has been used to measure the absolute intensity of the 2.7μ combination band of CO_2 in the temperature region 1,000° K to 3,000° K. The shock-heated samples were produced in a 4% CO_2–Ar mixture using helium as a driver gas. To insure adequate pressure broadening at high temperatures for this weak band, and yet remain within the optically thin region, the measurements were made at approximately 2.5 atm total pressure, 0.1 atm CO_2 partial pressure, and CO_2 optical path lengths up to a maximum of 0.5 cm-atm. The observed integrated band intensity of the 2.7μ CO_2 band increases by a factor of approximately 2.5 in going from 300° K to 3000° K. This variation with temperature is discussed in terms of a simple model.

Author

N63-17463 Avco-Everett Research Lab., Everett, Mass.
CURRENT SPEED IN A MAGNETIC ANNULAR SHOCK TUBE
James Keck May 1963 33 p 23 refs
(Contract AF 49(638)-659)
(Avco-Everett Res. Rept. 152)

A parametric study of the speeds of the current sheet and center-of-gravity of current in a magnetic annular shock tube has been carried out. The parameters varied include: (1) the drive current, (2) the polarity of the inner electrode, (3) the gas pressure, (4) the nature of the gas, (5) the radius of the inner electrode, and (6) the material of the inner electrode. The most interesting result of the investigation was the observation of limiting speeds for the current sheet and center-of-gravity of current of approximately 8 cm/μs and 3 cm/μs, respectively. These speeds were not exceeded even under conditions where the magnetic pressure exceeded the dynamic pressure by a factor of 10. The most probable explanation of the limiting speed is that it is due to the inertial drag of material ablated from the insulator at the driver end of the shock tube. Author

N63-17478 New York U. Courant Inst. of Mathematical Sciences, N.Y.
DRAG ON A BODY IN NEARLY-FREE MOLECULAR FLOW
Marian H. Rose Apr. 1, 1963 62 p 20 refs
(Contract AT(30-1)-1480)
(NYO-10427; MF-34)

A linearized Krook equation with the addition of a point source term is used to find the steady flow field in the vicinity of an object in nearly-free molecular flight through a nonionized gas. The point source is related to the shape of the object and to the boundary conditions, both at its surface and at infinity. A knowledge of the flow field and, therefore, of the distribution function near the body, permits the drag to be determined as a first-order perturbation on the free-molecular value. The cases of a plate and of a sphere undergoing specular and diffuse reflection, respectively, are worked out in detail. For specular reflection, the drag on a plate is evaluated for all Mach numbers; for diffuse reflection, due to the length of the calculation, only the case of a sphere at high Mach numbers is considered. The results, in both cases, are valid to first order in the Knudsen number. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-16994 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TESSERAL HARMONICS OF THE GRAVITATIONAL FIELD AND GEODETIC DATUM SHIFTS DERIVED FROM CAMERA OBSERVATIONS OF SATELLITES
William M. Kaula Washington, NASA, June 1963 20 p 28 refs
(NASA TN D-1848 OTS: $0.75

Baker–Nunn Camera observations of satellites 1959 α1 over 315 days, 1959 η over 105 days, and 1960 ι2 over 294 days were analyzed for 35 spherical harmonic coefficients of the earth's gravitational field and for position shifts of six geodetic datums. Of the three satellites, only 1960 ι2 appeared to have a sufficiently good observation distribution and small enough drag effects to yield significant results. The datum shifts obtained have standard deviations averaging ±25 m in each coordinate. The gravitational harmonic coefficients obtained appear to be appreciably different from zero for indices (n, m) at (2,2), (3,1), (4,1) and (4,3). Author

N63-17002 General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.
GRAPHIC DISPLAYS OF GEOMAGNETIC GEOMETRY
Walter F. Dudziak, David D. Kleinecke, and Theodore J. Kostigen Apr. 1, 1963 93 p 23 refs 60 maps
(Contract DA-49-146-XZ-109)
(RM-63TMP-2)

This report contains sixty maps presenting computational data pertaining to the geometric properties of the geomagnetic field, and a brief related theoretical description to make this material more meaningful. The maps display (1) the values of total field intensity (B) and McIlwain's magnetic shell parameter (L) for altitudes from zero to two thousand kilometers, (2) the detailed value of total field intensity near the South Atlantic anomaly, (3) the traces in both hemispheres of points with a fixed value of B and L, and (4) some other geomagnetic properties. The description includes tables of the geomagnetic coefficients used and a description of the codes utilized. Author

N63-17032 Weapons Research Establishment (Australia)
IONOSPHERIC DATA FOR JANUARY, 1962 FROM WOOMERA, SOUTH AUSTRALIA
Mar. 1963 24 p
(Ionospheric Data Bulletin CPD 1962/1(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for January, 1962. Author

N63-17074 Arizona State Coll. Atmospheric Research Observatory, Flagstaff
INFRARED ATMOSPHERIC STUDIES Final Report, 1 Nov. 1961-31 Oct. 1962
Arthur Adel May 1963 4 p
(Contract AF 19(628)-301)
(AFCRL-63-484)

In connection with Infrared Atmospheric Studies, a study dealing with the atmospheric windows at 6.3 microns and 16 to 24 microns, is summarized. Author

N63-17106 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRUCTURE OF THE UPPER ATMOSPHERE DEDUCED FROM CHARGED PARTICLE MEASUREMENTS ON ROCKETS AND THE EXPLORER VIII SATELLITE
R. E. Bourdeau and S. J. Bauer *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 1-18 33 refs (See N63-17105 15-29) OTS: $3.50

The ion composition measured directly at altitudes above the F2 peak by the Explorer VIII satellite is compared with the ion composition inferred indirectly from recent rocket measurements of charged-particle densities. These data show that there are two transition regions (from O^+ to He^+ and from He^+ to H^+) in the upper ionosphere, rather than a single transition from O^+ to H^+ as was previously believed. The results place the altitude at which $O^+/He^+ = 1$ between 800 and 1400 km, depending on the atmospheric temperature. The measured temperature in the upper ionosphere was found to be constant with altitude within a few percent, and consistent with a previously developed empirical relation which predicts the temperature as a function of diurnal time and of solar activity. The determined altitudes of the ion transition levels are in good agreement with a theoretical model which predicts these altitudes as a function of atmospheric temperature. Langmuir probe measurements of electron temperature made on the Explorer VIII satellite, together with those obtained on recent rocket flights, are compared with reference atmospheres.
Author

N63-17110 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COMPARISON AND COMBINATION OF SATELLITE WITH OTHER DETERMINATIONS OF GEODETIC PARAMETERS
William M. Kaula *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 p 119–124 11 refs (See N63-17105 15-29) OTS: $3.50

Three areas of geodetic interest can be defined in which it is desirable to compare satellite results with those obtained by terrestrial and lunar methods: (1) Variations in the gravity field. Determinations from satellite orbits of tesseral harmonics need an independent check. Terrestrial gravimetry at present is of dubious adequacy, except to confirm the order of magnitude of the variations determined by use of autocovariance analysis. An excellent partial check on the phase as well as the amplitude of the variations is the astrogeodetic geoid. For comparison, satellite data must be transformed from a harmonic to a spatial representation. (2) Station positions. Satellite data so far have yielded only the rather negative conclusion that the position determinations of the major continental geodetic systems are probably correct to within 100 meters. (3) The scale relationship between laboratory and satellite systems, most conveniently expressed in terms of GM. An appreciable discrepancy already exists between the GM value obtained from lunar observations and that obtained from terrestrial geodesy. Thus far, satellite results in this area are inconclusive. Author

N63-17112 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW-ENERGY TRAPPED PROTONS
Leo R. Davis and James M. Williamson *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 139–147 8 refs (See N63-17105 15-29) OTS: $3.50

A scintillation detector designed to measure the directional intensity and spectrum of 100 Kev to 4.5 Mev protons and the directional energy flux and spectrum of 10 to 100 Kev electrons has been flown on the Explorer XII satellite. Analysis of a portion of the data recorded during the last half of August 1961 has shown that (1) the radial distance to the outer boundary of the geomagnetically trapped radiation is variable, ranging from 8.5 to 11.0 R_e; (2) electrons are trapped more or less uniformly from 2 R_e to the outer boundary; and (3) protons are trapped throughout the same region. The proton intensity peaks on the dipole field line having an equational radius (R_0 value) of about 3.5 R_e, where the maximum intensity is 6×10^7 protons/cm^2-sec-ster. The proton spectra may be approximated by $\exp(-E/E_0)$ with, for example, E_0 values of 400, 120, and 64 Kev at R_0 values of 2.8, 5.0, and 6.1 R_e, respectively. During the magnetic storm which began on September 30, 1961, the proton intensity measured at high latitudes was enhanced by a factor of 3. The possibility that the main phase decrease of the storm was produced by the protons is discussed. Author

N63-17114 National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
EXPLORER X MAGNETIC FIELD RESULTS
J. P. Heppner, N. F. Ness, T. L. Skillman, and C. S. Scearce *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 169–211 44 refs (See N63-17105 15-29) OTS: $3.50

Magnetic-field measurements with the Explorer X satellite over geocentric distances of 1.8 to 42.6 R_e during the period March 25–27, 1961, are presented. Analysis of the close-in data suggests the existence of a very weak ring current below 3 R_e along the trajectory, but alternative explanations for the field deviations are possible. Between 8 and 22 R_e, the existence of a large-scale field directed away from the sun and earth within the geomagnetic cavity on the evening side of the earth is demonstrated. At distances greater than 22 R_e and prior to a sudden commencement of a magnetic storm late in the flight, the geomagnetic cavity boundary crossed the satellite trajectory on six principal occasions. Interpretations bearing on the form and boundary conditions of the cavity and solar-interplanetary fields external to the cavity are presented in the light of probable explanations and alternatives. Emphasis is placed on correlations with geomagnetic activity at the earth's surface.
Author

N63-17132 Kiruna Geophysical Observatory (Sweden)
AUDIO- AND SUBAUDIO-FREQUENCY ELECTROMAGNETIC RADIATION AT HIGH LATITUDE Final Report
Alv Egeland, Sven Olsen, and Georg Gustafsson Mar. 25, 1963 45 p 41 refs
(Contract AF 61(052)-600)
(AFCRL-63-475)

Fluctuations in the audiofrequency and sub-audiofrequency range have been extensively studied in recent years at Kiruna Geophysical Observatory (geomagnetic latitude 65.3° N). At this stage, the experimental results can be summarized under the headings of (1) band emission at gyro frequencies, (2) diurnal variation of the background noise between 10 cps and 10.000 cps as a function of frequencies and time, and (3) earth-ionosphere cavity resonances between 2 and 40 cps. Author

N63-17134 California U., La Jolla. School of Science and Engineering
COSMIC-RAY-PRODUCED STABLE ISOTOPES IN IRON METEORITES
Heinz Stauffer and Masatake Honda Repr. from J. Geophys. Res., v. 67, no. 9, Aug. 1962 p 3503-3512 18 refs
(NASA Grant NsG-97-60)
(NASA CR-50176)

The isotopic composition of vanadium, calcium, and potassium extracted from several iron meteorites was measured. The isotopes V^{50}, Ca^{46}, Ca^{43}, and K^{40} were found to be strongly enriched by cosmic-ray-induced spallation reactions. The concentrations of these isotopes were determined by isotopic dilution techniques. The results are compared with data on cosmogenic Sc^{45} and rare gas isotopes in order to determine the distribution of stable spallation products. The concentration C(A,Z) of a stable spallation product can be given as a function of the total mass loss $\Delta A = 56 - A$ by the equation $C(A, Z) = \gamma(A, Z)k_1(\Delta A)^{-k_2}$ where $\gamma = 1$ for cumulative and $0<\gamma<1$ for noncumulative isotopes. This equation is experimentally verified for a wide range of ΔA. The constants k_1 and k_2 were calculated for each meteorite. Especially from the constants k_2 we obtain information concerning the location of the samples inside of the preatmospheric meteorite bodies. Exposure ages were estimated by comparing the concentrations of K^{40} with those of stable isotopes. Comparison with Cl^{36}-Ar^{36} exposure ages indicates an essentially constant cosmic-ray bombardment during the time of exposure. Author

N63-17137 Alaska U. Geophysical Inst., College
THE AURORAL RAYS
Syun-Ichi Akasofu Repr. from J. Atmospheric and Terres. Phys., v. 25. 1963 p 163-165 11 refs
(NASA Grant NsG-201-62)
(NASA CR-50190)

A band which appeared over College (Alaska) on the night of March 24, 1962, provided an excellent chance to examine the ray structure of the aurora. Photographs of the bottom edge of the band suggest that the auroral rays are a small-scale folding structure produced by a positive space charge within the auroral electron sheet-beam. It seems unlikely, however, that the auroral draperies are related to the same type of instability. Author

N63-17141 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MAGNETIC FIELD OF THE RADIATION BELTS
Syun-Ichi Akasofu (Alaska U.) and Joseph C. Cain Washington, NASA, June 1963 10 p 5 refs
(NASA TN D-1762) OTS: $0.50

The magnetic fields produced by various types of belts of trapped particles are presented, in both tabular and graphical forms. Author

N63-17153 California U., La Jolla. School of Science and Engineering
RADIOACTIVE SPECIES PRODUCED BY COSMIC RAYS IN BRUDERHEIM AND OTHER STONE METEORITES
M. Honda, S. Umemoto, and J. R. Arnold Repr. from J. Geophys. Res., v. 66, no. 10, Oct. 1961 p 3541-3546 18 refs
(NASA Grants NsG-97-60 and NsG-98-60)
(NASA CR-50181)

In this paper, measurements are reported of the activity of 16 radioactive nuclides in the chondritic meteorite Bruderheim, which fell on March 4, 1960. The data are compared with those for the iron Aroos and other stone, iron, and stony-iron meteorites. For nuclides of $A \geq 46$, the activities normalized to iron and nickel content are closely similar. For lower A, the activities in stone are mainly produced in lighter elements. The spectrum of bombarding particles is shown to be closely similar in irons and stones. The results are consistent with a constant cosmic-ray intensity. Cosmic-ray bombardment ages of 30×10^6 years for Bruderheim and 130×10^6 years for Admire are calculated from rare-gas data and the activities of Na^{22}, Al^{26}, and Cl^{36}. Author

N63-17155 Southwest Center for Advanced Studies, Dallas, Tex.
THEORY OF AURORAL ELECTROJETS
J. A. Fejer Repr. from J. Geophys. Res., v. 68, no. 8, Apr. 15, 1963 p 2147-2157 18 refs
(NASA Grant NsG-269-62)

Two mechanisms are described for the formation of electrojet currents in the auroral zone. Both mechanisms require the existence of magnetospheric convection in which only particles of relatively low energy participate. It is essential to both mechanisms that particles of one sign (positively or negatively charged) should predominate among the energetic ones that do not participate in the convection of the magnetosphere. In the first mechanism the convection of the magnetosphere is taken to be of tidal origin, driven by the electric polarization fields associated with the dynamo current systems. In the second mechanism the convection is assumed to be the corotation of the magnetosphere with the earth, as modified by the solar wind that distorts the geomagnetic field. In both mechanisms the ionospheric currents are a consequence of the relative motion between the less energetic particles that almost fully participate in magnetospheric convection and the more energetic particles whose adiabatic drift motion across the magnetic field is only slightly perturbed by the electric fields associated with the convection of the magnetosphere. If the particles that do not participate are assumed to be the trapped energetic protons observed by Explorer 12 during magnetically quiet days, either mechanism predicts variations of the order of $\pm 50\gamma$ in the horizontal component of the geomagnetic field at auroral latitudes. Author

N63-17157 Houston U., Tex.
ULTRA-VIOLET-ABSORBING COMPOUND(S) REPORTED PRESENT IN THE MURRAY METEORITE
J. Oró (Calif. U.) Repr. from Nature, v. 197, no. 4869, Feb. 23, 1963 p 756-758 11 refs
(NASA Grant NsG-257-62)
(NASA CR-50299)

Investigations reported were undertaken to ascertain whether the compounds detected in meteorite extracts are indigenous to the meteorite or are the results of contamination by the ion-exchange resin technique used. Investigation results show that the ultraviolet spectra obtained from meteorite extracts passed through Dowex 1 and the spectra given by blank eluates from Dowex 1 are essentially identical. It was concluded that the ultraviolet-absorbing compounds detected in water extracts of the Murray meteorite after treatment with Dowex 1 came from the resin and not from the meteorite. Observations concerning the presence of similar water-soluble ultraviolet-absorbing substances in Dowex 2 are also described. N.E.A.

N63-17161 Southwest Center for Advanced Studies, Dallas, Tex.
FURTHER COMMENTS ON STABILITY OF INTERFACE BETWEEN SOLAR WIND AND GEOMAGNETIC FIELD
A. J. Dessler Repr. from J. Geophys. Res., v. 67, no. 12, Nov. 1962 p 4892-4894 6 refs
(NASA Grant NsG-269-62)
(NASA CR-50152)

Recent surface magnetometer, space-probe, and satellite data suggest that the interface between the solar wind and the magnetosphere is stable, rather than turbulent as commonly assumed. The concept of a standing shock wave maintained by the solar wind impinging on the magnetosphere is proposed to explain the observed stability of the magnetospheric boundary existing at about 10 earth radii geocentric distance on the sunward side. This hypothesis supposes a shock front between

the supersonic solar wind and the compressed, slower solar wind region at about 14 earth radii. In the region between the magnetosphere and the shock front (10 to 14 earth radii) the magnetic field is very irregular, but the flow of solar plasma past the magnetosphere is grossly stable. Assuming that this hypothesis is correct, the K_p index in geomagnetism becomes a measure, not of the increase or decrease of solar flow past the magnetosphere, but of the time rate of change of plasma plus magnetic pressure on the magnetosphere. M.P.G.

N63-17172 Iowa State U., Iowa City
STUDY OF ENERGETIC ELECTRONS AND THEIR RELATIONSHIP TO AURORAL ABSORPTION OF RADIO WAVES
B. Maehlum and B. J. O'Brien Repr. from J. Geophys. Res., v.68, no. 4, Feb. 15, 1963 p 997–1010 28 refs
(NASA Grant NsG-233-62; Contract NOonr-93803)

The high-latitude boundary (L_N) of energetic electrons ($E \gtrsim 40$ Kev) quasi-trapped at an altitude of 1000 km was studied with the satellite Injun I over North America during periods of magnetic quiet and magnetic storms in 1961. The boundary was very sharp during disturbed periods, and it moved farther from the pole during larger disturbances. The electron intensity south of L_N increased during magnetic disturbances, and the electron spectrum was much softer than normal just at the boundary. Throughout two magnetic storms in October and December 1961, the boundary (L_N) of the energetic electron flux coincided with the boundary of the auroral absorption of radio waves. Quantitative correlation of the intensities of the two phenomena is discussed. Author

N63-17190 Minnesota U. School of Physics, Minneapolis
OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 3. THE INNER BELT
R. A. Hoffman, R. L. Arnoldy, and J. R. Winckler Repr. from J. Geophys. Res., v. 67, no. 1, Jan. 1962 p 1–12 14 refs
(NASA Contract NASw-56)

The differential energy spectrum of an assumed power law form for trapped protons in the inner belt has been determined from data received from the ion chamber and Geiger counter aboard the earth satellite Explorer VI. Above an energy of 30 Mev, the spectrum has the form of $E^{-1.65}$ at about -28° geomagnetic latitude. The spectrum has been checked by comparison of the actual proton counting rate of the triple rate of the triple coincidence telescope aboard Explorer VI in the inner belt with the rate calculated from such a spectrum. It is then shown that the counting rate from the scintillation counter aboard Explorer VI is probably due primarily to electrons. Electron fluxes at the maximum of the inner belt are given as about 2×10^9 electrons/cm^2 sec from 200 to 500 kev, or about 1×10^7 electrons/cm^2 sec greater than 500 kev at -28° geomagnetic latitude. The spectra obtained are shown to be in agreement with those previously published, and not in conflict with the spectrum calculated from neutron albedo decay. The data also place an upper limit of about 10 percent for time variations caused by magnetic storms, although they are probably consistent with no variations at all. Author

N63-17311 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VI: ELECTRON TEMPERATURES IN THE IONOSPHERE
M. B. Mc Elroy, R. J. Moffett (Queen's U.), and A. Dalgarno Nov. 1962 62 p 26 refs
(NASA Contract NASw-395)
(NASA CR-12; GCA-TR-62-11-N) OTS: $6.60 ph, $2.06 mf

Detailed calculations are described of the rate of heating of the ambient electrons arising from solar ultraviolet radiation, and it is shown that the resulting difference between the electron temperature and the gas temperature at noon in a quiet ionosphere may reach a maximum value lying between 800° K and 1500° K at an altitude near 200 km, but the difference vanishes below about 120 km and above about 400 km. Author

N63-17317 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XII: THE ROLE OF INTERPLANETARY DEBRIS IN PLANETARY ATMOSPHERES: I. SODIUM IN THE EARTH'S ATMOSPHERE
F. F. Marmo and H. K. Brown Mar. 1963 38 p 19 refs
(NASA Contract NASw-395)
(NASA CR-13, GCA-TR-63-4-N) OTS: $3.60 ph, $1.34 mf

Investigations of planetary atmospheres are conducted to explain the extraterrestrial origin of sodium. First, sodium in the Earth's atmosphere is examined to check the validity of the physical-mathematical model, boundary conditions, and parametric values employed. Second, with identical debris influx rates assumed for both Venus and Mars, the distribution of sodium in their atmospheres is calculated. All computations are presented on a relative scale for ready comparison. Results indicate that there is considerable more free sodium in the atmospheres of Venus and Mars than that which exists in the Earth's atmosphere. This is apparently due to the fact that the total oxygen contents of the atmospheres of Venus and Mars are believed to be about 1 part in 10^5 of that of Earth. I.v.L.

N63-17318 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY XIII: ELECTRON AND ION TEMPERATURES IN THE IONOSPHERE
A. Dalgarno Apr. 1963 20 p 12 refs
(NASA Contract NASw-701)
(NASA CR-6, GCA-TR-63-11-N) OTS: $1.60 ph, $0.80 mf

The relationships between the temperatures of the electrons, positive ions, and neutral particles of the ionosphere are discussed. On the basis of the heating due to solar ultraviolet radiation, it is felt that the electron and ion temperatures will become equal at high altitudes, and that both tend to increase above the neutral particle temperature. Anomalously high values of the electron temperature, accompanied by a red glow, are predicted to occur in the region of 400 km during the dawn period. The expected diurnal and latitudinal variations of the electron temperature are described. Author

N63-17423 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
PRELIMINARY RESULTS OF DENSITY MEASUREMENTS FROM AN AIR FORCE SATELLITE Research Note
H. Pond (Navy Underwater Sound Lab.), J. Mc Isaac, and C. Stergis Feb. 1963 15 p 4 refs
(AFCRL-63-245)

Atmospheric density was determined from a singly mounted ionization gage flown on an Air Force satellite. Included is a brief description of the experiment and theory, as well as a discussion of some of the problems involved in performing these measurements. Density data are given for the altitude range of 370 to 400 km during early morning hours for the two days 17 and 18 June 1961. Results are compared with those of the 1961 revised U.S. Standard Atmosphere. Author

N63-17437 Georgia Inst. of Tech. Engineering Experiment Station, Atlanta
STUDY OF PHOTOCHEMISTRY, PHYSICAL STATE AND MOTION OF THE UPPER ATMOSPHERE Final Report
Howard D. Edwards Mar. 1963 136 p 24 refs
(Contract AF 19(604)-5467; ARPA Order-42; Proj. Defender)
(AFCRL-63-488)

The primary objectives were to gather photographic data from chemical releases which took place under code name Project Firefly, and to analyze these data in terms of physical state and motion of the upper atmosphere. From an understanding of the upper atmosphere constants, as determined from the chemical release studies, the phenomena associated with missile trails can be studied and evaluated. Some photometric, spectrographic, and television-camera data were obtained. Several reports were written covering the various technical aspects of the work. This report is essentially a compilation of these reports. Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-17189 Avco-Everett Research Lab., Everett, Mass.
STAGNATION POINT HEAT TRANSFER MEASUREMENTS IN PARTIALLY IONIZED AIR
P. H. Rose and J. O. Stankevics Apr. 1963 51 p 47 refs
(Contract AF 04(694)-33)
(Avco-Everett Res. Rept. 143; BSD-TDR-62-348)

Experimental measurements of convective stagnation-point heat transfer in partially ionized air, at simulated flight velocities up to 55,000 ft/sec, are presented. Stagnation-point heat-transfer rates were measured in an arc-driven shock tube. Calorimetric heat-transfer gages, either coated with silicon-monoxide films or uncoated, were used to measure heat transfer. The effects of boundary-layer chemistry, radiation from the hot inviscid flow, and instrumentation errors are discussed. Comparison is made of the measured heat-transfer rates with other data, and the points of agreement and disagreement are analyzed. The data are compared to theoretical predictions made with a simple binary diffusion model of partially ionized diatomic gas, namely, nitrogen, whose transport properties were estimated from measured and calculated cross-section data. It is concluded that the transport properties of air up to 15,000° K are known to reasonable accuracy, and that heat conduction by electrons does not present a serious engineering problem for flight velocities up to 50,000 ft/sec.
Author

N63-17192 Michigan U. Coll. of Engineering, Ann Arbor
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER Fifth Quarterly Progress Report
Richard E. Balzhiser, Robert E. Barry, C. Phillip Colver, Herman Merte, Jr., Andrew Padilla, Jr., and Lowell R. Smith Wright-Patterson AFB, Ohio, Flight Accessories Lab., May 1963 32 p 7 refs
(Contract AF 33(616)-8277)
(Rept. 04526-17-P)

Pool-boiling data has been obtained for potassium from the outside of a 7/8-in.-diameter bayonet tube. Boiling curves were determined at pressures up to 45 psia, and burnout measurements were taken for pressures up to 20 psia. The burnout flux at 1 atm. was 610,000 Btu/(hr)(sq ft) and showed less pressure dependence than predicted by the relationships of Noyes, Zuber–Tribus, and Kutateladze. Author

N63-17250 Atomics International, Canoga Park, Calif.
DYNAMIC VOID FRACTION MEASUREMENT SYSTEM
J. H. Kendron, E. E. Stoner, and G. M. Taylor May 15, 1963 48 p 40 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7875) OTS: $1.25

Various methods and techniques of measuring void fraction in boiling heat-transfer media are discussed. Details of 17 void-fraction-measurement systems are abstracted. A dynamic void-fraction-measurement system is described, capable of continuously measuring void fraction at any position along a 12-ft test section. Author

N63-17259 Stanford U., Calif.
THE EFFECT OF TRANSVERSE TEMPERATURE GRADIENTS ON THE HEAT TRANSFER AND FRICTION FOR LAMINAR FLOW OF GASES
Monty E. Davenport Washington, AEC Div. of Tech. Inform. July 31, 1962 121 p 28 refs
(Contract AT(04-3)-247)
(Tech. Rept. 247-3; TID-17792) OTS: $2.50

The results of an experimental and analytical investigation of the frictional and heat-transfer effects for the flow of gases through heated channels at flow rates such that the flow may be regarded as laminar are described. The treatment is restricted to a consideration of the steady flow of gases through tubes of circular cross section. A velocity component transverse to the main flow stream is postulated; and the effect of this component is included in the analysis by means of appropriate terms in the governing equations. An approximation equation expressing this transverse flow rate is developed from energy-transfer considerations. Experimental data obtained in the investigation were presented. It was predicted by the analysis and verified by the experimental data that the local friction factor increases rapidly with increasing temperature ratio; furthermore, the postulated radial velocity effect is adequate to explain this variation of the friction factor with temperature ratio. The heat-transfer results were less conclusive than the friction-factor results, but the data did not contradict the results of the analysis. N.E.A.

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

N63-17063 Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa.
EFFECTS OF ACCELERATION ON PILOT PERFORMANCE Report No. 8
Randall M. Chambers Mar. 26, 1963 71 p 30 refs
(NADC-MA-6219)

This report attempts to consolidate the findings of both prior and recent research in the area of acceleration effects upon pilot performance, and to relate these findings to basic piloting behaviors. The decrements in the visual, psychomotor response and intellectual processes which have been found to accompany acceleration stress are quantified where possible. Both transverse and positive accelerations have been shown to raise the level of contrast required for visual brightness, and to reduce general acuity at acceleration loads well below those which result in gross visual impairment. Similar impairments in discrimination response rates are also discussed. The techniques thus far used to assess higher mental ability under acceleration are presented as are some of the problems which complicate such measurements. Data from such studies are presented to illustrate the reduction in immediate memory and information-processing capabilities of pilots experiencing both high-level, short-term, and moderate, extended accelerations. Author

N63-17275 Army Ordnance Missile Command, Redstone Arsenal, Huntsville, Ala.

THE HUMAN AS A MISSILE SYSTEM COMPONENT

R. F. Chaillet and Alvin Steinberg *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 121–123 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Reliability achievement is approached by an analysis of the human factors influencing the design and reliability of missile systems. It is found that human engineering greatly influences and controls the design of the system and that often human errors in the design cause test failures. Constant design review is then recommended to improve reliability, along with laboratory environmental tests and complementary analysis, prior to field testing of the assembled system. Human errors during field systems tests are found to occur in three areas: maintenance, prefiring adjustment, and at or after launch operations. The following recommendations are made to reduce the possibility of human error during reliability testing: (1) Keep the design simple with a minimum of test requirements and a maximum of modular subsystem items that are replaceable in the field; (2) keep the "prepare to launch" phase of complex missile systems to a minimum, since this is the area of greatest human error, and (3) make training adjunct to effective system design, not a substitute for it. D.E.R.

N63-17276 General Electric Co. Missile and Space Vehicle Dept., Philadelphia, Pa.

THE ROLE OF HUMAN FACTORS IN WHITE ROOM MANUFACTURING RELIABILITY

Edward I. Gavurin *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 125-131 3 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper is concerned with both the role which human performance plays in white-room manufacturing reliability, and the techniques for optimizing this performance within a controlled environmental work setting. Consideration has been given to the effect of selection, training, motivation and morale, and the special requirements for glove-handed operations upon the reliability of the white-room workers. Author

N63-17394 Michigan U. Inst. of Science and Tech., Ann Arbor

CONTINUOUS HUMAN ESTIMATION OF A TIME-VARYING, SEQUENTIALLY DISPLAYED PROBABILITY

Gordon H. Robinson May 1963 70 p 26 refs (Contract DA-36-039-SC-78801; Proj. Michigan) (Rept. 2900-281-T)

This experiment examines the human ability to give a direct magnitude estimate of a time-varying probability. The subject positioned a "tracking" lever at his estimate of the current mean of a sequentially displayed binary distribution. The distribution samples were presented at a fixed rate by two flashing lights. The distribution mean changed in step increments of varying size and spacing. The experimental variables included flash rate and a constraint on the randomness of the flash series. Detailed measurements were made of both the transient and static responses to each step change. The transient response was more rapid and consistent than had been anticipated, and occurred with step changes as small as 0.12. The average static response showed no systematic bias as a function of probability, and had an rms error approximately equal to that of a 17-sample average. Two simple mathematical models are derived to provide quantitative comparisons with the subjects' data. A descriptive model is also derived which satisfies some basic properties of the task behavior. The parameters for this model are selected for two specific experimental situations. Author

N63-17412 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

OPERATIONS – FLIGHT CREW REQUIREMENTS

Richard E. Day *In its* Manned Orbital Operations Spec. Section [1963] p 74 (See N63-17401 15-32)

The selection programs and the training regimes undergone by astronauts for both the Mercury project and for future space missions are outlined and emphasis is placed on the role of flight simulation in the training procedure. D.E.R.

N63-17416 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

VISUAL CAPABILITY IN RENDEZVOUS

Jack E. Pennington and Roy E. Brissenden *In its* Manned Orbital Operations Spec. Section [1963] p 96–99 18 refs (See N63-17401 15-32)

Previous studies of visual perception and acuity as they apply to the human control of orbital rendezvous are summarized and the results of several experiments on pilot performance in rendezvous maneuvers are presented. Data given includes: the physiological threshold of visual perception, the effects of pre-exposure brightness on adjustment and dark adaptation, the effect of flash duration on the apparent intensity of light seen by the eye, the effect of flash rate on the sighting of an object, the human angular rate perception and correction factors, distance judgement, the threshold of velocity perception, and the effects of color, illumination, and aspect on visual judgement. It is concluded that a pilot can discharge the primary docking and rendezvous duties, and that devices to aid the pilot should not subordinate the pilot to the equipment. D.E.R.

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

***For related information see:* 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.**

N63-16989 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL EVALUATION OF LIQUID-FLUORINE SYSTEM COMPONENTS
Richard L. De Witt and Harold W. Schmidt Washington, NASA, June 1963 22 p 5 refs
(NASA TN D-1727) OTS: $0.75

A prototype "quick-disconnect" coupling for ground-to-vehicle transfer of liquid fluorine was designed, developed, and successfully tested. The coupling proved satisfactory at flow rates up to 2.5 lb/sec and pressure differentials up to 23 lb/sq in. One commercially available rotating-vane flowmeter was tested for liquid-fluorine compatibility. A valve design employing a soft-seal material at the flow shutoff interface proved successful at flows of 2.0 lb/sec and valve inlet pressures up to 97 lb/sq in. abs. In support of the valve design, dynamic liquid-fluorine compatibility testing was conducted on six soft-seal materials. Author

N63-17001 Aerojet-General Corp. Liquid Rocket Plant, Sacramento, Calif.
DEVELOPMENT OF PERISCOPE FOR THRUST CHAMBER COMBUSTION ANALYSIS Final Report [15 Apr. 1962-14 Apr. 1963]
' ' O'Donnell May 28, 1963 55 p 1 ref
(Contract AF 04(647)-652, S/A 4)
(Rept. 652/SA4-2.2-F-1, Vol. 6)

Progress in developing a periscope to permit visual study of high-frequency instability and other phenomena of the combustion process in full-scale thrust chambers is reported. A quartz dome capable of withstanding exposure to combustion gases at 850-psi chamber pressure has been developed and tested; and the optical and mechanical designs of the experimental periscope have been completed. Two quartz dome fixtures were studied: one was polished to optical quality and the other was not polished; neither showed signs of failure. Test results are summarized. D.E.R.

N63-17028 California Inst. of Tech. Div. of Geological Sciences, Pasadena
TEN MICRON PHOTOMETRY OF 25 STARS FROM B8 TO M7
Robert L. Wildey and Bruce C. Murray May 13, 1963 20 p 18 refs Submitted for Publication
(NASA Grant NsG-56-50)
(NASA CR-50143) OTS: $1.60 ph, $0.80 mf

A photometer employing a liquid hydrogen-cooled mercury-doped germanium photoconductor, whose spectral response is limited to the 8μ to 14μ region by a low-pass interference filter, and a BaF_2 window coupled with the cell's threshold wavelength, has been placed at the east arm Cassegrain focus of the 200-inch Hale telescope. Twenty-five stars have been measured. The earliest star for which two measurements have been obtained is the B8Ia star β Orionis. The latest star is the M7e star X Cygni. The brightest star, 1.37×10^{-14} watts/cm^2, is α Orionis. The carbon star DS Peg was also measured. Author

N63-17068 Aro, Inc., Arnold Air Force Station, Tenn.
SPACE SIMULATION CHAMBER INSTRUMENTATION
M. R. Mulkey, R. E. Klautsch, G. A. Rayfield, and F. G. Sherrell Arnold Engineering Development Center, June 1963 70 p 22 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-113)

The measurement of chamber and test-vehicle parameters in large space-environmental chambers has become a new technology in the field of instrumentation. Modification of old established techniques and the development of new techniques for the purpose of measurement of multichannel parameters associated with space-chamber testing has become of utmost importance in recent years. This paper contains a comprehensive state-of the-art examination in the field of space-environmental-chamber instsumentation. Author

N63-17082 General Electric Co. Research Lab., Schenectady, N.Y.
PERFORMANCE CHARACTERISTICS AND EMISSION COOLING MEASUREMENTS TAKEN ON A Cs VAPOR THERMIONIC CONVERTER WITH A THORIUM-TUNGSTEN EMITTER Scientific Report No. 1
J. M. Houston May 1963 39 p 12 refs
(Contract AF 19(604)-8424)
(AFCRL-63-450)

Measurements made on a Cs-vapor thermionic converter having a 13.3 cm^2 Th-W emitter indicate that in the retarding range of the converter, the emission cooling is just what simple theory would predict. However, for collector-to-emitter voltages more positive than approximately –1.3 volts, the emission cooling fell far below that predicted by simple electron emission form the emitter, indicating that large amounts of power (as much as 20 watts/cm^2 at positive collector voltages) was flowing from the plasma back to the emitter. This anomaly in the emission cooling is interpreted in terms of resonance radiation, excited atoms, and ions returning to the emitter. These originate in a region of high electron temperature adjacent to be emitter. Author

N63-17109 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE UTILIZATION OF IONOSPHERE BEACON SATELLITES
G. W. Swenson, Jr. (Illinois U.) *Ih its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 91-117 103 refs (See N63-17105 15-29) OTS: $3.50

This paper discusses the application of beacon transmitters in earth satellites to ionospheric research, and the need for worldwide cooperation in beacon-satellite observation. The theories of Faraday rotation and Doppler methods of determining atmospheric electron content are reviewed briefly, and the working formulas are listed. Desirable characteristics of beacon satellites are outlined. Methods of observation and equipment are discussed in some detail, as are the minimum standards for the production of high-quality data. An extensive bibliography is also presented. Author

N63-17149 National Bureau of Standards, Boulder, Colo.
INSTRUMENTS FOR THE CONTINUOUS MEASUREMENT OF THE DENSITY OF FLOWING FLUIDS
C. E. Miller, R. B. Jacobs, and J. Macinko Repr. from Rev. Sci. Instr., v. 34, no. 1, Jan. 1963 p 24–27 4 refs
(NASA Order R-45)
(NASA CR-50160; R-274)

This paper describes the development of a new electromechanical method of measuring the densities of flowing cryogenic fluids. The instrument uses a movable section of flow passage, vibrated transversely at a constant amplitude and frequency, as the sensing element. A dynamometer, inserted between the flow passage and driver, continuously measures the acceleration reaction (product of mass and acceleration) of the fluid in the passage. A measure of this reaction is also a measure of the fluid density in the passage. Performance results indicate that the densitometer should be well suited for service in liquid oxygen and nitrogen single- and two-phase flow systems, and with only minor changes for use with liquid hydrogen. Author

N63-17197 Los Alamos Scientific Lab., N. Mex.
STUDY OF FISSION NEUTRON SPECTRA WITH HIGH-ENERGY ACTIVATION DETECTORS
James A. Grundl May 20, 1963 170 p 53 refs
(Contract W-7405-eng-36)
(LAMS-2883) OTS: $2.75

The energy spectra of neutrons from the fission of U235, U233, and Pu239 have been studied with seven high-energy activation detectors covering the range 0.6 to 16 Mev. Interpretation is in terms of the Maxwellian spectral function $E^{1/2} \exp(-E/T)$. By means of a unique cavity arrangement within a moderator to obtain pure thermal-neutron-induced fission neutrons, the average energies of the three spectra are found to be in the ratios

U235:U233:Pu239 = (1):(1.016±0.003):(1.039±0.003)

Differences between the normalized spectra are most pronounced at high energies as exemplified by the relative Pu239:U235 flux ratios 1.17±0.013 for 6 < E < 11 Mev, and 1.35±0.03 for E < 11 Mev. Author

N63-17209 Aeronautical Research Council (Gt. Brit.)
THE USE OF A DEEP ELECTROLYTIC TANK AS A LIFTING-SURFACE CALCULATOR
H. S. Ward (Birmingham U.) London, HMSO, 1963 52 p 29 refs
(ARC-R&M-3301; previously issued as ARC-22974) Available from HMSO: £1

An investigation of a deep electrolytic tank, applied as a lifting-surface calculator, has been made. The reasons for the initial choice of apparatus, and its subsequent behavior are detailed. The calculator was developed for use with the investigation of plane surfaces, plane control surfaces, and a symmetrically cambered wing. The results have been compared with existing theoretical and experimental work. Author

N63-17233 Aeronautical Research Labs., Melbourne (Australia)
A STUDY OF THE VARIABILITY OF FATIGUE METERS, WITH REFERENCE TO RESULTS FROM FOKKER FRIENDSHIP AIRCRAFT
A. K. Patterson, M. G. J. Higgs, and F. H. Hooke Sept. 1962 30 p 2 refs
(ARL-SM-276)

Flight load data from 9 Fokker Friendship aircraft for 18 months have been analyzed. An average gust spectrum for these aircraft has been drawn, and the seasonal variation in gust severity has been established. A factorial analysis has shown significant differences between results on different aircraft (or aircraft + meter combinations). This has led to the assessment of standards of accuracy to which the meters should conform on calibration test. Author

N63-17238 Cornell U. Lab. of Atomic and Solid State Physics, Ithaca, N.Y.
VACUUM ULTRAVIOLET MONOCHROMATOR
P. L. Hartman Repr. from Rev. Sci. Instr., v. 33, no. 10, Oct. 1962 p 1082-1087 5 refs
(NASA Grant NsG-212)

A new focusing vacuum monochromator is described which incorporates features that make available a simple and flexible double monochromator with a single control. The focusing is provided with a linear motion coupled to a nearly balanced linkage system which, coupled to the grating, satisfies the conditions of the Rowland mount. Entrance and exit slits, variable in width, are offset to either side of the plane of the Rowland circle, which is of one meter diameter. Transparent window valves allow the isolating of the lamp and detector chamber from the monochromator, and maintaining the vacuum while making visual or near UV checks through the instrument. A filter wheel is built in to obviate some of the difficulty with scattered radiation when the instrument is used singly. Two units have been built and mounted so as to allow changeover to the double system. Author

N63-17328 Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa.
RECORDING INSTRUMENT FOR ENVIRONMENTAL TESTING OF BIOLOGICAL SPECIMENS
George H. Kydd Mar. 26, 1963 13 p 2 refs
(NADC-MA-6119)

This report describes the modification of a strip chart recorder for use in recording, long term, the conditions of an environmental system used for subjecting animals to gas mixtures in which the oxygen content is varied. Provisions are made for recording four pressures, six temperatures, and four 10-mv signals, which in this case, consist of two gas flowmeters, and oxygen and carbon dioxide analysis. Author

N63-17422 Washington U., Seattle
THE INVESTIGATION OF SOME TECHNIQUES FOR MEASUREMENT OF HUMIDITY AT HIGH ALTITUDES Scientific Report No. 1
Robert J. Charlson and K. J. K. Buettner Mar. 1963 21 p 9 refs Papers presented at Intern. Symp. on Humidity and Moisture, Washington, D.C., May 20–23, 1963
(Contract AF 19(628)-303)
(AFCRL-63-415)

Two approaches to the problem of measuring humidity at high altitudes are described. The first consists of the adaptation of the principle of gas chromatography to the separation of minute amounts of water from air. The laboratory experiments and apparatus are described. A possible design for an automatic chromatographic hygrometer is presented. The second approach consists of the use of the chromatographic packing as the dielectric of a small capacitor. The results of experiments with this new technique are presented. This device is unique inasmuch as its response can be described by an acceptable theory. The results of a literature survey are summarized. Author

N63-17435 Aerospace Medical Center. School of Aerospace Medicine, Brooks AFB, Tex.
EXPERIMENTAL CALIBRATION OF SEMICONDUCTOR DETECTOR PULSE-HEIGHT RESPONSE TO PROTONS
James D. Hall (Texas Nuclear Corp.), George W. Crawford, Thomas A. Alexander, Hartmut A. W. Spetzler, and Joseph S. Pizzuto Mar. 1963 12 p 2 refs
(SAM-TDR-63-21)

Significant progress has been made toward accomplishing measurement of the energy absorbed from a proton as a function of the path length of the proton in the sensitive volume of a semiconductor detector. Surface barrier P-N and P-i-N detectors have been used in the study utilizing path lengths as short as 100μ and as long as 10 cm. Protons of initial energy of 16, 40, and 187 Mev have been used. Other proton energies (8 to 166 Mev) were obtained by using absorbers in the proton beam. Energy calibrations were accomplished by total absorption of protons of known energy. Author

N63-17439 Texas Instruments, Inc., Dallas
DIGITAL SEISMOGRAPH SYSTEM Final Report
Bruce M. Williams Mar. 29, 1963 170 p refs
(Contract AF 19(628)-472; ARPA Order 180-61, Amend. 2; Proj. Vela-Uniform)
(AFCRL-63-433)

This report covers work done since 16 April 1962 on the research, design, and construction of a prototype three-component Digital Seismograph System. The approach chosen for complete system design was termed the FM-Digital approach. Displacement of the boom, which is attached to the differential-capacitor plates, generates a zero- to 40-megacycle FM deviation which drives a binary counter for 20 bits of digital conversion at a 40-cps rate. System evaluation consisted of comparison with a conventional three-component Benioff seismograph. Because of the wide dynamic range of the digital seismograph system, detailed evaluation requires the use of computer analysis of data obtained. Author

N63-17444 Princeton U. Plasma Physics Lab., N.Y.
MEASUREMENT OF ABSOLUTE RADIATION INTENSITIES IN THE VACUUM ULTRAVIOLET REGION
Einar Hinnov and Fritz Hofmann Apr. 1963 31 p
(Contract AT(30-1)-1238)
(MATT-186)

A method for calibrating vacuum ultraviolet monochromators for measurement of absolute radiation intensities is described. It is based on calculating the brightness of an optically thin spectral line in the far ultraviolet from the brightness of a visible line originating from the same upper level. A grazing incidence monochromator and a Seya–Namioka monochromator were calibrated at a number of wavelengths between 1640 A and 231 A, using line pairs of hydrogen and ionized helium. Light sources used to obtain these lines are described. Problems of measurement and sources of error, particularly in the case of hydrogen-like spectra, are discussed. Author

N63-17467 European Organization for Nuclear Research, Geneva (Switzerland)
A FILM ANALYSER
J. Richez Mar. 27, 1963 29 p 1 ref
(CERN-63-10)

Operations of a film analyzer are described. The purpose of building this instrument is to develop a scanning device for solving simple problems directly from photographs. The device can be used for oscilloscope traces and as a pattern generator to analyze spark chamber pictures. N.E.A.

N63-17469 European Organization for Nuclear Research, Geneva (Switzerland)
AN IONIZATION CHAMBER FOR THE ESTIMATION OF THE BIOLOGICAL EFFECTIVENESS OF RADIATION
A. H. Sullivan and J. Baarli May 1, 1963 19 p 7 refs
(CERN-63-17)

A simple, parallel plate, ionization chamber has been constructed to study the possibility of using its properties for measuring the average specific ionization of secondary radiation. The chamber has been operated with pressures of up to 6 atmospheres of tissue equivalent gas and with field strengths of up to 2000 volt/cm. It has been found that the collected ionization current can be represented over a considerable range of field strengths by $i = K V^n$, where K is a function of dose-rate and type of radiation, V is the electric-field strength, and n is an index, depending only on the type of radiation used. The response of such a chamber can be deduced from existing theories of columnar recombination, enabling the index n to be related to recommended values of RBE. Various sources of radiation of accepted value of RBE have been used to calibrate the chamber and to check the calculated response. It is estimated that the chamber will measure the RBE of any mixture of radiation to within 20%. Author

N63-17470 Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.
EXPERIMENTAL EVALUATION OF A DULL-ELEMENT TRANSDUCER FOR HIGH-TEMPERATURE-GAS MEASUREMENTS [Final Technical Report]
J. T. Chambers, D. L. Rall, and W. H. Giedt Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Mar. 1963 55 p
(Contract AF 33(657)-8411)
(ARL-63-58)

An experimental evaluation was made of a dual-element transducer, in which gas-stream temperatures are inferred from simultaneous temperature-time measurements of two transducers of equal shape but unequal thermal capacity. The major effort was expended on measuring medium-temperature streams to prove the feasibility of the concept. The accuracy of the transducer was within ±6% in measurements from 1950° to 2250° F, which was the best experimental accuracy predicted by an earlier analysis of the concept. A limited number of measurements were made with the transducer directly in an oxyacetylene flame. The indicated flame temperatures were 4700° F and 4789° F, which agree within 5% with measurements made by sodium-line-reversal techniques for equivalent combustion conditions in tests conducted at the University of California. In a third series of tests, the transducer was used to traverse a 2100° F gas stream, and from a single record the temperature profile in the stream was calculated within the accuracy to which the true profile could be established. It is concluded that the dual-element transducer is feasible for all the applications tested. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-17036 Chicago U. USAF Radiation Lab., Ill.
Quarterly Progress Report No. 47 [RESEARCH ON CERTAIN BIOLOGICAL AND MEDICAL ASPECTS OF ATOMIC ENERGY]
Kenneth P. Du Bois Apr. 15, 1963 184 p 116 refs
(Contract AF 41(609)-1693)

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THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA OR FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS

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N63-17037 Chicago U. USAF Radiation Lab., Ill.
INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF YOUNG MALE RATS
Bernard E. Hietbrink, Marjorie Keshmiri, and Kenneth P. Du Bois *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 1–12 8 refs (See N63-17036 15-16)

Studies were undertaken to determine the influence of repeated exposures of 100 r or 200 r of X-irradiation on the development of the phosphorothioate-oxidizing enzyme system in the livers of young male rats. It was found that the enzyme activity of the livers of rats which were given 100 r or 200 r of X-ray at 23 days of age, and a like dose at 37 days of age, reached the normal adult level at approximately the same time as the livers of animals which were irradiated at 23 days. Administration of the second dose of 100 r or 200 r of X-ray at 30 days of age increased the period of radiation-induced inhibition of development of enzyme activity. The injection of 200 mgm/kgm of MEA ten minutes before 500 r of X-ray failed to substantially reduce the radiation-induced inhibition of the synthesis of the drug-metabolizing enzyme system in the livers of young male rats. The results of experiments on the influence of partial body shielding indicated that the administration of 800 r of X-irradiation to the liver area of 23-day old rats caused a substantial inhibition in the rate of synthesis during the 12- to 21-day period following radiation. Measurements of the influence of daily intramuscular injections of adrenal cortex extract on the radiation-induced inhibition of the development of the phosphorothioate-oxidizing enzyme system were performed. Results of these measurements indicated that daily injections of adrenal cortex extract reduced the degree of radiation-induced inhibition in the synthesis of the drug metabolizing enzymes in the livers of young male rats. Author

N63-17038 Chicago U. USAF Radiation Lab., Ill.
THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES
Bernard E. Hietbrink, Marjorie Keshmiri, and Mary E. Hayward *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 13–21 11 refs (See N63-17036 15-16)

A study was conducted to determine the influence of 2-imino-thiazolidine-4-carboxylic acid on the radiation-induced changes in the enzyme activity of the spleens, thymus glands, and intestines of rats. It was found that administration of 140 mgm/kgm of the thiazolidine (expressed as equivalents of HCN) ten minutes before X-irradiation provided 19% and 16% reductions in the biological effect of 400 r in the spleens and small intestines, respectively. Administration of this compound 25 minutes before radiation provided substantial protection to the spleens but did not benefit the other tissues studied. Increasing the dose of the thiazolidine to 175 mgm/kgm failed to enhance the protective activity in the hematopoietic tissues. The combination of 140 mgm/kgm of 2-imino-thiazolidine-4-carboxylic acid and 200 mgm/kgm of MEA did not reduce the biological effect of X-irradiation to the extent of MEA given singly. Experiments were undertaken to obtain information concerning the radioprotective activity of mixtures of cysteine and MEA or cysteine and AET when administered orally. These studies indicated that mixtures of 1,000 mgm/kgm of cystein with 200 mgm/kgm or 250 mgm/kgm of MEA provided moderate reductions in the biological effect of radiation in the hematopoietic tissues, but did not benefit the intestines when given 30 minutes before X-ray. Doses of AET ranging from 300 mgm/kgm to 700 mgm/kgm were given in combination with 1,000 mgm/kgm of cysteine. The mixture containing 1,000 mgm/kgm of cysteine and 600 mgm/kgm of AET was the most effective, and provided reductions of 37%, 22% and 25% in the biological effects of X-irradiation in the spleens, thymus glands, and intestines, respectively. Results of studies on the effects of 140 mgm/kgm of 2-imino-thiazolidine-4-carboxylic acid on the 30-day survival of rats given 850 r of X-ray showed that the administration of this agent ten minutes before radiation permitted 60% survival. One of the five rats given the thiazolidine derivative 25 minutes before radiation survived the test period. Administration of the compound 25 minutes after 850 r of X-ray enhanced the lethal effects of radiation as indicated by a marked reduction of the median survival time. Author

N63-17039 Chicago U. USAF Radiation Lab., Ill.
INFLUENCE OF X-IRRADIATION ON THE REDUCTASE ACTIVITY OF THE LIVERS OF PARTIALLY HEPATECTOMIZED RATS

Kenneth P. Du Bois and Bernard E. Hietbrink *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 22–28 8 refs (See N63-17036 15-16)

Measurements of the reductase activity of the livers of female mice indicated that the enzyme activity was slightly lower than the activity of the livers of male mice. The enzyme activity of the livers of normal male guinea pigs was 25% to 35% of the level of activity in the livers of rats and mice. The reductase activity of the livers of partially hepatectomized male rats was measured on unirradiated rats and on comparable animals given 200 r of X-irradiation 18 hours after hepatectomy. No difference was observed between the enzyme activity of the irradiated and unirradiated animals. Conduction of the reductase assay under aerobic conditions also did not reveal any differences between irradiated and control animals, thus indicating that utilization of reduced triphosphopyridine nucleotide through oxidative reactions was not sufficiently inhibited by this dose of radiation to cause accumulation of reduced triphosphopyridine nucleotide. Author

N63-17040 Chicago U. USAF Radiation Lab., Ill.
THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE

V. Plzak, M. Root, and J. Doull *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 29–53 3 refs (See N63-17036 15-16)

The present report contains the results of toxicity and radioprotective evaluation studies on thirty-four additional chemical compounds in male CF_1 mice. Seven of these compounds were found to exhibit significant radioprotective activity in that they reduced the 30-day mortality of the X-rayed mice. The most marked effect was obtained with PD-77 which allowed 60% of the mice to survive for 30 days after an otherwise lethal X-ray exposure. Two compounds protected 40% of the mice in a similar manner. They were VI-5, a biguanide derivative of Phenformin, and PD-37. PD-35 protected 20% of the X-rayed animals against the 30-day mortality and a bunte salt, 1-(1-pyrrolidinocyclohexyl)-methyl thiosulfuric acid (UI-1), protected 17%. The rest of the compounds found to be effective in these tests produced a 30-day survival of 10% of the mice given the whole-body X-ray exposure of 700 r. These compounds were: glutathione preparations, AI-1 and AI-2; Phenformin derivatives, VI-1 and VI-3; and PD-78 and PD-82.

Author

N63-17041 Chicago U. USAF Radiation Lab., Ill.
THE EFFECTS OF PRE-IRRADIATION AND POST-IRRADIATION ADMINISTRATION OF CYANIDE AND OTHER COMPOUNDS ON RADIATION LETHALITY IN MICE

J. Dilley and J. Doull *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 54–76 6 refs (See N63-17036 15-16)

An optimal dose of potassium cyanide equal to 2.25 mgm/kgm of HCN and 2.50 mgm/kgm as HCN has been found to afford maximum protection against higher doses of X-ray in female and male CF_1 mice, respectively. Higher but nonlethal doses seemed to cause diminution of the protective effect. An unpurified mixture of 2-imino-thiazolidine-4-carboxylic acid has been shown to protect female CF_1 mice against lethal doses of whole-body X-ray, and the apparent dose reduction factor is about 1.2 based on these studies. Author

N63-17042 Chicago U. USAF Radiation Lab., Ill.
THE EFFECT OF CHEMICAL PROTECTION ON LIFE-SPAN SHORTENING IN X-IRRADIATED MICE

J. Doull, V. Plazak, and J. Cowan *In its* Quarterly Progr. Rept. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 77–102 6 refs (See N63-17036 15-16)

The longevity of female CF_1 mice given various chemical radioprotective agents prior to acute X-ray exposures of 400 r, 600 r, and 800 r has been compared with that of nonirradiated animals given the protectors, and with nonprotected irradiated animals in order to determine whether any of these agents reduce or prevent the lifespan-shortening effects of acute X-ray exposure. Pretreatment with serotonin creatinine sulfate (30 mgm/kgm IP) increased the age-corrected median survival time of the X-rayed mice by about eight weeks, but the protective effect is small in comparison with the ability of this agent to prevent acute (30-day) radiation effects. Mice pretreated with p-aminopropiophenone (30 mgm/kgm IP), 2-aminoethylisothiourea dichloride (200 mgm/kgm IP), or 2-mercaptoethylamine hydrochloride (300 mgm/kgm IP) prior to the administration of X-ray doses of 600 r or 800 r exhibited age-corrected median survival times comparable or less than those seen in animals given these X-ray doses without protection. All of these agents increased the median survival time of mice given 400 r of X-irradiation, but correction of the lifespan-shortening data for the increase in longevity produced by the administration of the agents alone eliminated the apparent protective effects in these animals. No evidence was obtained in the present studies that pretreatment with the radioprotective agents decreased the incidence of other delayed radiation sequelae. Author

N63-17043 Chicago U. USAF Radiation Lab., Ill.
EFFECT OF VARIOUS RADIOPROTECTION TREATMENTS IN MICE

H. D. Landahl and A. T. Hasegawa *In its* Quarterly Progr. Rept. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 92–102 6 refs (See N63-17036 15-16)

Use of an external 1/4-inch lead shield (0.1 × 2 × 0.7 cm) placed over the spleen of mice increased the LD_{50} for whole-body X-ray exposure from about 450 r to 890 r. The administration of serotonin (100 mgm/kgm intraperitoneally) in addition to the external shielding of the spleen increased the LD_{50} to about 1,075 r, whereas MEA (400 mgm/kgm intraperitoneally) plus spleen shielding increased the LD_{50} to about 1,200 r. MEA alone was about as effective as spleen shielding alone. Hydroxylamine given prior to whole-body X-ray exposure at a dosage level of 50 mgm/kgm results in a slight protection, but increasing the dose to 200 mgm/kgm (given over a period of 15 minutes to minimize toxicity) increases the LD_{50} of whole-body X-ray exposure to over 800 r giving a dose reduction factor (DRF) of close to 2. Anoxia produced by exposing mice to an environmental oxygen concentration of about 4.6% increased the LD_{50} of whole-body X-ray exposure to about 1,000 r. Production of anoxia within 10 seconds after X-ray exposure gave no protective effect. Administration of sodium cyanide at different times prior to an X-ray exposure of 700 r showed that the greatest survival occurred when the agent was given at four minutes prior to the irradiation. Experiments involving the topical application of drugs to the spleen gave the following results: substantial degrees of protection could be obtained with histamine and 2-aminoethylisothiourea, but the amounts required to produce protection were comparable to the amount of each agent required to produce radioprotective effects when given intravenously. Electric shocks to the spleen failed to yield a significant protective effect. Administration of 400 mgm/kgm of MEA and 200 mgm/kgm of $NaNO_2$ before 1,300 r resulted in 30-day survivors, indicating an additive protective effect. Author

N63-17044 Chicago U. USAF Radiation Lab., Ill.
EARLY AND LATE RADIOPROTECTIVE EFFECTS IN PROTON-IRRADIATED MICE PRETREATED WITH CHEMICAL PROTECTORS
D. G. Oldfield, J. Doull, V. Plzak, A. Hasegawa, and A. Sandberg *In its* Quarterly Progr. Rept. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 103–134 3 refs (See N63-17036 15-16)

Previous studies of radioprotection against 440-Mev proton radiation have been replicated and extended, confirming the original conclusion that preirradiation treatment with MEA and PAPP are able to reduce 30-day mortality in CF_1 mice. A new assay parameter, survivance, defined as the time integral of the fractional number of animals surviving to a given time, is introduced, and several of its properties and intended uses discussed qualitatively. Judged on the basis of the survivance at 100 days, MEA protects more effectively than PAPP against 440-Mev protons. Author

N63-17045 Chicago U. USAF Radiation Lab., Ill.
GROSS AND MICROSCOPIC PATHOLOGY IN MICE GIVEN CHEMICAL RADIO-PROTECTIVE AGENTS PRIOR TO IRRADIATION WITH 400 MEV PROTONS
D. Vesselinovitch, F. Fitch, D. G. Oldfield, V. Plzak, and J. Doull *In its* Quarterly Progr. Rept. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 135–154 28 refs (See N63-17036 15-16)

Autopsy and histopathological findings in the tissues of male mice are presented. These mice were given 2-mercaptomethylamine or *p*-aminopropiophenone prior to whole-body irradiation with high-energy (440 Mev) protons or X-rays. The most frequent pathological finding at autopsy in the proton-irradiated mice was hemorrhage in the form of petechiae or echymosis, involving rather large areas of the affected organs. The organs most frequently involved were the lungs, testis, brain, lymph nodes, and adrenal glands. Hemorrhages were also observed in various parts of the gastrointestinal tract (including the liver), in the urinary bladder, kidney, abdominal subcutaneous tissues, and even in the heart of a few animals given the highest doses of the whole-body proton radiation. Another frequent finding was moderate to marked fatty changes in the liver. Hemorrhages similar to those found in the proton-irradiated animals were seen in many of the X-rayed mice. The organs most frequently involved were the brain, lungs, testis, and kidneys. Fatty livers were also observed occasionally and one animal had pinpoint whitish spots in the liver. C.L.W.

N63-17046 Chicago U. USAF Radiation Lab., Ill.
STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY
David W. Bruce and Kenneth P. Du Bois *In its* Quarterly Progr. Rept. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 155–165 11 refs (See N63-17036 15-16)

Intravenous administration of 20 mgm/kgm and 30 mgm/kgm of praseodymium as the nitrate salt caused no significant decrease in the blood glucose of male rats. This is in contrast to the marked decrease in blood glucose in female rats caused by an equitoxic dose of this compound. Evidence presented in this report indicates that dietary intake of 6 to 9 grams per day of sucrose or dextrose by female rats will prevent the mortality resulting from the intravenous administration of 2 mgm/kgm of praseodymium as the nitrate salt. Dietary intake of 2 to 3 grams of dextrose or 6 to 9 grams of fructose per day was ineffective in preventing mortality. The results suggest that the mortalities are due to the decreased blood glucose. Intravenous administration of 20 mgm/kgm of praseodymium to male rats as the nitrate salt reduced the glucose-6-phosphatase activity of the liver 17% and 15% in 24 and 48 hours after administration, respectively. Four mgm/kgm of praseodymium alone or in combination with 500 r of X-irradiation had no effect on the glucose-6-phosphatase activity of the liver of female rats four hours after administration. Fatty infiltration of the liver may account for the 18% to 25% decrease in activity found after 24 hours. A 20% and 33% increase in mortality was observed when a sublethal dose of intravenous praseodymium (1 mgm/kgm) was given 10 to 15 minutes prior to 300 r and 500 r of whole-body X-irradiation. Author

N63-17047 Chicago U. USAF Radiation Lab., Ill.
LONGEVITY IN F_1 HYBRID OFFSPRING OF IRRADIATED MICE
Ann M. Budy, John H. Rust, D. J. Mewissen, and Robert D. Boche *In its* Quarterly Progr. Rept. No. 47 [Research on Certain Biological and Medical Aspects of Atomic Energy] Apr. 15, 1963 p 166–180 26 refs (See N63-17036 15-16)
(Contracts AT(11-1)-37 and AF 33(638)-27353)

This experiment was designed in an attempt to study the longevity of offspring from an irradiated and a nonirradiated parent. Mice of strains dba and C-57 Black were mated and crossmated 56 days before and 10, 120, and 180 days after 200 r whole-body X-irradiation was delivered either to the male or female parent. There was a reduction in the number of successful pregnancies, and in the litter size of the 120-day and 180-day matings with the irradiated male parent. This reduction in pregnancies did not hold for the irradiated female parent in the 10-day mating; they were sterile in subsequent matings. The percentage of animals born and living until weaned and the distribution of sexes at weaning time did not follow a consistent pattern. Irradiation of the male parent reduced the lifespan of its progeny without regard to their sex, whether conceived immediately after irradiation or 120 or 180 days later. It is likely that spermatozoa were irradiated in the first matings and spermatogonia in the second and third. Irradiation of the female parent did not reduce the lifespan of its progeny, regardless of sex. Females given 200 r whole-body X-irradiation were sterile at 120 and 180 days after exposure. Author

N63-17050 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
SPACE MEDICINE
W. Randolph Lovelace II *In* Advisory Group for Aeronautical Research and Development, Paris (France) Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961 [1961] p 53–64 (See N63-17048 15-01)

The requirements for a manned space mission are discussed and recent advances in aerospace medicine due to manned orbital flight are listed. The effects of environmental stress, acceleration, space radiation, nuclear propulsion, and changes in ambient time cycles on biological systems are discussed. The results of the search for extraterrestrial life are given. D.E.R.

N63-17092 California U., Los Angeles. School of Medicine
EFFECTS OF ANTI- AND PSEUDO-PARKINSON DRUGS ON SHIVERING
D. G. Stuart, R. George, W. J. Freeman, A. Hemingway, and W. M. Price Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 13 p 23 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-17)

Effects of atropine, an anti-Parkinson agent, and reserpine, a pseudo-Parkinson agent, on the intensity of shivering in cats were determined. This intensity was measured by the ratio of shivering oxygen-consumption rate (VO_2) to resting VO_2. At

a dose level (5 mg/kg IP) in excess of that necessary to suppress Parkinson or experimentally-induced alternating tremor, atropine sulphate had no effect on the intensity of cold-induced shivering. At a dose level of 0.5 mg/kg IV, reserpine suppressed shivering, but evoked an alternating tremor with Parkinson characteristics. Author

N63-17093 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
ARCTIC SURVIVAL RATIONS. X. DIURNAL VARIATIONS OF SOME LIVER CONSTITUENTS IN RATS FED PEMMICAN MEALS
D. A. Vaughn and R. L. Winders Mar. 1963 11 p 9 refs
(AAL-TDR-62-54)

Diurnal variations in liver glycogen content and the activities of certain liver enzymes following 2-hour feeding periods were studied in trained-fed rats adapted to high-carbohydrate or carbohydrate-free diets. The results indicated that time after feeding a high-carbohydrate meal affected the activities of glucose-6-phosphatase and glutamic-pyruvic transaminase, but not glucose-6-phosphate dehydrogenase. These time-related changes were modified by meal-feeding the carbohydrate-free diet. Glycogen deposition following a carbohydrate-free meal indicated a rapid takeover of gluconeogenesis. Author

N63-17094 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
CHANGES IN THE INTESTINAL FLORA OF GROUND SQUIRRELS DURING PERIODS OF HIBERNATION
J. P. Schmidt and R. E. Becker Mar. 1963 8 p 4 refs
(AAL-TDR-62-55)

Counts were made of the coliform bacilli and psychrophilic organisms in the intestinal contents of arctic ground squirrels while the animals were in the active state and, again, following periods of hibernation. In addition, total viable aerobic cell counts were obtained. Data are presented which indicate that there was a significant increase in the number of psychrophiles and a simultaneous decrease in the number of coliform bacilli during hibernation. No changes were found in the total cell counts which could be associated with hibernation. Author

N63-17095 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
ALTERATIONS OF PROTEIN METABOLISM DURING COLD ACCLIMATION
G. J. Klain and D. A. Vaughn Jan. 1963 18 p 35 refs
(AAL-TDR-62-60)

The changes in the protein metabolism in animals exposed to cold are discussed. Work of the authors has shown that a moderate cold exposure is an effective agent in correcting and overcoming amino acid imbalances in the rat, and that both substrate-induced and cold-induced enzymatic changes occur in cold-exposed animals. Author

N63-17096 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
EFFECT OF PROTEIN INTAKE AND COLD EXPOSURE ON SELECTED LIVER ENZYMES ASSOCIATED WITH AMINO ACID METABOLISM
G. J. Klain, D. A. Vaughn, and Lucile N. Vaughn Jan. 1963 10 p 24 refs
(AAL-TDR-62-61)

The activity of five liver enzymes involved in amino acid metabolism was found to be markedly increased in cold-exposed rats. However, the activity of three of the enzymes, arginase, glutamic-oxalacetic and glutamic-pyruvic transaminase, was increased only as a result of a cold-induced higher protein intake. In contrast, the activity of tryptophan pyrrolase and tyrosine alpha ketoglutaric transaminase was increased by cold *per se*. The data demonstrate that both substrate-induced and cold-induced enzymatic changes occur in cold-exposed animals. Author

N63-17097 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
INTERRELATIONSHIPS OF COLD EXPOSURE AND AMINO ACID IMBALANCES
G. J. Klain, D. A. Vaughn, and Lucile N. Vaughn Jan. 1963 12 p 16 refs
(AAL-TDR-62-62)

A moderate cold exposure has been used as a tool in inducing a higher food intake in experiments dealing with amino acid imbalances in the rat. The data indicate that the rats kept at 25° C suffer a severe metabolic disorder after ingesting amino acid imbalanced diets. In contrast, the animals kept at 7° C readily consumed the inbalanced diets and, consequently, grew as well as the controls. The activity of the glutamic-oxalacetic and the glutamic-pyruvic transaminase was found to be increased as a result of a cold exposure. It is suggested that a moderate cold stress is an effective agent in correcting and overcoming amino acid imbalances. Author

N63-17193 Kentucky U., Lexington
MAINTAINING THE THERMAL BALANCE IN MAN
L. D. Carlson Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Jan. 1963 18 p 10 refs Presented at Inst. of Radio Engr., New York, Mar. 28, 1962
(Contract AF 41(657)-335)
(AAL-TDR-62-24)

A report is presented which briefly characterizes the heat production of the human being, and the heat exchange with the environment. The mechanisms whereby the temperature-control system operates are presented. These characteristics are schematically shown in fourteen figures. Author

N63-17206 California U., Los Angeles. Medical Center
POTENTIAL FOR TELEMETRY IN THE RECORDING OF BRAIN WAVES FROM ANIMALS AND MEN EXPOSED TO THE STRESSES OF SPACE FLIGHT
W. Ross Adey Repr. from Bio-Telemetry, N.Y., Pergamon Press 1963 p 289-302
(NASA Grant NsG-203-62)
(NASA CR-50205)

Work done over the past three years to test the feasibility of the telemetry of EEG's from animals and men in space flight, including the booster and reentry phases of flight, is reported. Four areas are covered: (1) the development of appropriate implantation techniques to permit recording from deep brain structures; (2) the development of special hardware for both recording of the EEG and the behavioral training; (3) the special testing that is involved in the environmental aspect of centrifuging and shaking during recording; and (4) data analysis as a requirement in flight to minimize telemetry requirements. N.E.A.

N63-17265 California U., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology
CURRENT INTERPRETATION OF THE HIPPURAN I^{131} RENOCYSTOGRAM
Earl K. Dore, George V. Taplin, and DeLores E. Johnson May 1963 32 p 10 refs
(Contract AT(04-1)-GEN-12)
(UCLA-512)

The original description of the renogram's three segments fostered two widespread misconceptions. The first segment, a crude index of the volume of blood within the kidney, was misconstrued to be a measure of renal blood flow. The second segment, a sensitive gage of renal blood flow, was incorrectly considered an indicator of tubular cell functional capacity. A revised nomenclature is recommended, which describes more accurately the major events registered, namely tracer appearance, blood flow and drainage, to replace the original terms of vascular, tubular, and excretion. The first, or tracer, appearance segment is no longer considered a useful index of renal vascular volume, because radioactivity of blood within the kidney contributes in only a minor way to its height. Extrarenal components predominate. The slope of the second segment is an index of individual renal blood flow, because tracer is retained in the kidney during this time and about 92% of Hippuran in trace quantities is extracted from the blood with each passage through the kidney. The third segment detects interference with urine drainage from the kidney. The term drainage is preferable to excretion which may imply an active cellular process.
Author

N63-17277 Douglas Aircraft Co., Inc. Missiles and Space Systems Div., Santa Monica, Calif.
RESOURCES TO SUPPORT A MAN-MACHINE SYSTEM
W. W. Haythorn (RAND Corp.) and Evan Wilken Pickrel *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 133–140 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper describes a procedure for estimating direct maintenance personnel requirements. A model is presented for gathering information. A sample problem is used to describe manipulation of the information to derive a manning document.
Author

N63-17306 Argonne National Lab., Ill.
THEORY OF ALKALINE EARTH METABOLISM. THE POWER FUNCTION MAKES POSSIBLE A SIMPLE BUT COMPREHENSIVE MODEL OF SKELETAL SYSTEMS
John H. Marshall *In its* Radiological Physics Div. Semiannual Report, Jan. through June 1962 Feb. 1963 p 5–29 31 refs (See N63-17305 15-01)

A simple way has been found to incorporate the power function, so useful in describing the retention of radioactive bone-seekers, into a metabolic model which agrees surprisingly well with data for the behavior of radioisotopes of calcium, strontium, barium, and radium in dog and in man. The power function is a mathematical expression in which the independent variable (time) is raised to a constant power (usually not an integer). The behavior of the model can be completely determined by a set of three parameters.
Author

N63-17329 Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Pa.
LEVER DISPLACEMENT DURING A DISCRIMINATION-DIFFERENTIATION Report No. 10
Robert M. Herrick Apr. 8, 1963 32 p 7 refs
(NADC-MA-6303)

The maximum displacement of the T-bar handle of a rat-response lever was recorded under two schedules: (1) programed variable-duration S^D and S^Δ periods, with reinforcement only for S^D presses between 23.45° and 28.64° (Position 5), and (2) the same requirements for a reinforcement as in (1) but with S^Δ initiated only by a "wrong" press in S^D, and prolonged by any press in S^Δ. With this lever, work is linearly proportional to displacement. Under the first schedule: (1) S^D distributions differed significantly from their companion S^Δ distributions, although the lever position showing the greatest percentage of presses in S^D often corresponded with the one showing the greatest percentage in S^Δ, and (2) both mean lever displacement and variability were consistently greater in S^Δ than in S^D. Under the second schedule: (1) S^D distributions differed significantly from their companion S^Δ distributions, but the $S^D - S^\Delta$ distributions were positively correlated, and (2) mean lever displacement was about the same in S^D and S^Δ, but variability was consistently greater in S^Δ. Under both schedules: (1) the previously established discrimination was disrupted initially, but eventually reached very high levels; (2) the final shape of the S^D distribution was asymmetrical with respect to Position 5—more presses occurred below than above Position 5; (3) the greater the distance from Position 5, the lower the final percentage achieved; and (4) while the mean response rate in S^D decreased under lowered motivation, the distance the lever was pressed remained unchanged.
Author

N63-17346 California U., Los Angeles. School of Medicine
ANATOMY OF THE HYPOTHALAMUS AND ITS CONNECTIONS
D. G. Stuart Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 23 p 65 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-13)

This report briefly summarizes hypothalamic anatomy in terms of boundaries, cellular groups, intra, efferent and afferent connections, and ontogenetic development. Wherever possible, discussion is directed or limited to aspects of hypothalamic anatomy that are of special significance to the nervous control of shivering. For this reason, the connections between the septal area of the forebrain and the hypothalamus are emphasized.
Author

N63-17347 California U., Los Angeles. School of Medicine
EFFECTS OF DECEREBRATION AND DECORTICATION ON SHIVERING IN THE CAT
D. G. Stuart, W. J. Freeman, and A. Hemingway Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 20 p 29 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-15)

The effects of decerebration and decortication on the metabolic intensity of shivering in cats were determined. There was neither shivering nor an appreciable rise in the oxygen-consumption rate of chronic decerebrate cats during rapid cooling. The intermittent somatomotor activity that was induced by rapid cooling was occasionally tremulous, but it was also evoked by rapid warming and was absent during slow cooling and warming. This suggests that the motor activity of decerebrate cats during rapid cooling, more a generalized avoidance response to nociceptive stimulation than a temperature-regulating mechanism. In decorticate cats, shivering was depressed three days after surgery, the mean shivering to nonshivering ratio in oxygen consumption rate being 1.6 ±0.12 (SD), while the same ratio before operation was 2.6 ±0.48 (SD). One month after decortication, shivering had returned to its preoperative intensity. This suggests that the net telencephalic influences on shivering could hardly be suppressive, as suggested by some earlier investigators.
Author

N63-17348 California U., Los Angeles. School of Medicine
ACTIVATION AND SUPPRESSION OF SHIVERING DURING SEPTAL AND HYPOTHALAMIC STIMULATION

D. G. Stuart, Y. Kawamura, and A. Hemingway Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 39 p 57 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-16)

In acute experiments on 38 lightly anesthetized cats, the septal region of the forebrain and the hypothalamus were explored for loci whose activation by electrical stimulation produced, suppressed, or failed to affect shivering. Shivering was consistently and repeatedly produced by stimulation of the dorsomedial region of the posterior hypothalamus, and sometimes by stimulation of the ventrolateral region of the septum. A greater intensity of stimulus was needed to produce more latent and less intense shivering during septal than during hypothalamic stimulation. Similarly, more intense stimulation was necessary to suppress shivering during ventromedial septal stimulation than during anterior, or ventrolateral posterior hypothalamic stimulation. The most effective stimulation frequency for both activation and suppression of shivering was 50 pulses/sec, i.e., fivefold the evoked or suppressed limb-tremor frequency. On the basis of these results, it was concluded that septal influences on shivering are secondary to a primary hypothalamic modulation of this tremor. Such modulation appears to be more concerned with initiation and maintenance than with the rhythm of shivering. Author

N63-17349 California U., Los Angeles, School of Medicine
EFFECTS OF SEPTAL AND HYPOTHALAMIC LESIONS ON SHIVERING
D. G. Stuart, Y. Kawamura, A. Hemingway, and W. M. Price Ft. Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 16 p 28 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-18)

Shivering and heat loss in the cold were determined in 46 cats several weeks or months after bilateral destruction of various septal and hypothalamic regions. Septal lesions had no effect on either parameter. The tremor was abolished or markedly reduced in cats with lesions in the dorsomedial region of the posterior hypothalamus, but postural, pilomotor, and behavioral responses to cooling persisted. Lesions of the dorsolateral region of the posterior hypothalamus increased heat loss despite the presence of shivering, huddling, and piloerection. These results confirm previous electrical stimulation data that the primary region controlling the efferent (motor) aspect of shivering is the dorsomedial region of the posterior hypothalamus, and additionally, indirectly suggest that the dorsolateral region of the posterior hypothalamus is implicated in cold-induced cutaneous vasoconstriction. Author

N63-17434 Pittsburgh U. Graduate School of Public Health, Pa.
A CYTOGENETIC STUDY OF SOME RADIUM DIAL-PAINTERS AND THEIR PROGENY
Charles E. Miller (ANL), Niel Wald, Wayne H. Borges, Jip Kim, and Allen Brodsky Brooks AFB, Tex., School of Aerospace Med., Apr. 1963 11 p 20 refs
(Contract AF 41(657)-361)
(SAM-TDR-63-1)

Preliminary cytogenetic analyses were performed on four radium dial-painters, and the crude average exposure dose to their bone marrow was estimated. Two instances of increased aneuploidy and three of increased chromosomal aberrations were observed in the four subjects, who had cumulative average bone-marrow doses of 800 to 1,400 rem obtained at an average dose rate of 20 to 35 rem a year. Cytogenetic analyses were also performed in the progeny of four dial-painters, selected because of a history of frequent miscarriages and congenital anomalies. Among these were three instances of definite congenitial anomaly. Increase aneuploidy was observed in all three patients. Author

N63-17442 Oak Ridge National Lab., Tenn.
THERMOLUMINESCENCE SPECTRA AND ACTIVATION ENERGIES FOR AROMATIC AMINO ACIDS, TRYPSIN, AND SPORES OF BACILLUS MEGATERIUM
C. J. Weinberg, J. G. Carter, D. R. Nelson, and R. D. Birkhoff (M.S. Thesis) June 21, 1963 127 p 74 refs
(Contract W-7405-eng-26)
(ORNL-3115) OTS: $2.50

The spectral distribution of the thermoluminescence and the activation energies associated with peaks of the glow curves for aromatic amino acids, trypsin, and spores of Basillus megaterium are determined. Glow curves are presented for each of the substances investigated. The experimental glow curves are presented as actual photomultiplier current vs. temperature. A comparison between the experimental glow curve and the one corrected for photomultiplier response is also presented for each material. The thermoluminescence is presented for the temperature range 77° K to 280° K, at ten-degree intervals. Each spectrum represents the calculated wavelength distribution of the light from the sample at that temperature. The activation energies calculated using the method of initial rise are tabulated. The activation energies were also calculated using the kinetic analyses. N.E.A.

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-16998 Marlin-Rockwell Corp., Jamestown, N.Y.
DESIGN CRITERIA FOR ROLLING ELEMENT AIR FRAME BEARINGS FOR HIGH ALTITUDE USE [Final Report]
Harold E. Munson, Jamshed B. Havewala, and John H. Johnson Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Apr. 1963 92 p 5 refs
(Contract AF 33(616)-6650)
(MRC-1299; ASD-TDR-62-900)

The investigation constitutes an experimental study in the field of aircraft control bearings directed toward evaluation of bearing roll configurations, bearing materials, and bearing lubricants for operation in the temperature range of 1200° F, at a simulated altitude of 250,000 feet. Four different roll designs, together with twelve different material combinations, were investigated. Resulting best design and two best material combinations were subjected to stresses up to 325,000 psi at the temperature and vacuum. One-inch-diameter bore, self-aligning, double-row roller bearings fabricated from 6B vs. 6B carried loads to 5,000 lbs (280,000 psi) for 40,000 cycles at 1200° F and vacuum. DF-700 dry film (MoS_2-sodium silicate), when applied to all contact surfaces, gave superior performance among five different dry films investigated. Friction coefficients with the lubricants were in the range of .08 to .25. Successful bearing operation requires considerable deviation from design criteria for fluid-lubricated bearings. Test results suggest that a single-row bearing of the BR-16 type could sustain the same loads with less torque. Author

N63-17072 Ampex Corp., Redwood City, Calif.
EXTERNALLY PRESSURIZED, AXISYMMETRICAL FOIL BEARINGS
Edward Barlow Apr. 1963 39 p 8 refs
(Contract Nonr-3815(00))
(RR-63-4)

An externally pressurized axisymmetrical foil bearing was analyzed in order to obtain the qualitative effect of side leakage in a foil bearing. One or two circumferential pressure sources, symmetrically placed, were used. In the analysis, bending stiffness of the foil was included, and was found to be important. Curves were obtained which show the effects of the various physical parameters on the gap profile. Author

N63-17077 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
A PROCESS FOR MAKING GRAPHITE LESS PERMEABLE TO GASES AT HIGH TEMPERATURES
G. R. Tully, Jr. and B. F. Disselhorst Washington, AEC Div. of Technical Information, Feb. 1, 1963 98 p 24 refs
(Contract AT(04-3)-314)
(GA-2318) OTS: $2.25

A process for treating commercial graphite to lower its permeability to the order of 1×10^{-5} cm^2/sec, by a series of impregnations with a furfuryl alcohol type of monomer, is described. Graphites with maximum pore diameters up to 40μ, as measured by mercury porosimetry, can be treated. The impregnant is heated to >2650° C in the process, so the treated material is suitable for high-temperature applications, as in the core of a nuclear reactor. Details of the experimental procedure and equipment, and the effect of the process on the properties of the graphite are given. Tubes of HLM-85 graphite, 4 ft long and 3 1/2 in. in outside diameter, with a wall thickness of 3/8 in., have been treated to permeabilities of $<1 \times 10^{-5}$ cm^2/sec by the process. Author

N63-17087 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DESIGN AND APPLICATIONS OF MODULAR PACKAGING OF EQUIPMENT: AN ANNOTATED BIBLIOGRAPHY
George R. Evans, comp. May 1962 33 p 49 refs
(Contract AF 04(647)-787)
(Rept. 3-77-62-1; SB-62-25)

The subject areas surveyed include rack design and housing for independent functional equipment, with stress on optimum reliability and maintainability along with efficient space utilization. Units or components which comprise the electronic, electrical and mechanical circuitry, and functional capability of equipment, systems, etc., are considered. Author

N63-17098 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska
AN EXPERIMENTAL WINTER FLYING GLOVE
Paul W. Barnett and Kermit R. Skrettingland Jan. 1963 9 p 8 refs
(TN-63-1)

Loss of tactile discrimination and dexterity during critical phases of flight are common to arctic operations. The development of more efficient handwear would greatly enhance flying safety. A mouton glove was designed which maximized insulation and minimized impairment. Following field trials, this glove was compared with the MA-1 glove and the N-4B arctic mitten. Although the experimental glove compared favorably, it possessed no advantages worthy of additional consideration. Author

N63-17117 Armour Research Foundation, Chicago, Ill.
ULTRASONIC METHODS FOR NONDESTRUCTIVE EVALUATION OF CERAMIC COATINGS [Interim Report Apr. 1, 1962-Mar. 31, 1963]
A. M. Baumanis and W. E. Lawrie Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 47 p refs
(Contract AF 33(657)-8938)
(WADD-TR-61-91, Pt. III)

Techniques for determining the strength and integrity of ceramic-metal bonds are investigated. Primary emphasis was placed on techniques for examining diffusion coatings although work continued on flame-sprayed coatings. Extensive investigations of Rayleigh wave techniques have been made with promising results. Further work was done using the Schlieren optical method, and thermal effects were investigated in relation to the Schlieren results. Investigations of an interferometric method for measurements of elastic constants have shown the method to have low accuracy. Neither destructive nor nondestructive methods have been found to successfully measure bond strength of diffusion coatings. Preliminary investigations have been made of thermal, electrical, and nuclear methods for examining flame-sprayed coatings. Author

N63-17138 Cryogenic Engineering Lab., National Bureau of Standards, Boulder, Colo.
DRY GAS OPERATION OF BALL BEARINGS AT CRYOGENIC TEMPERATURES
L. E. Scott, D. B. Chelton, and J. A. Brennan Repr. from Advances in Cryogenic Eng., v. 7, 1962 p 273-276 2 refs
(NASA Order R-45)
(NASA CR-50182; R-201)

Tests have been conducted to determine if high-speed rotating machinery can be operated in a cold gaseous hydrogen environment with ball bearings, and to extend previous data to include dry hydrogen gas operations. The operating requirements on the bearings were indicated as follows: speed — 9200 rpm; thrust load —30 lb; torque —as low as possible, but not to exceed 5 in.-oz. per bearing; and life —20 hr minimum. The bearings tested were ball bearings of 26-mm OD by 10-mm bore having 440-C stainless steel balls and races. The separator was Rulon A (reinforced polytetrafluorethylene resin which contains an inert, inorganic, silicate base filler). The results obtained indicate that if proper cooling is maintained, these bearings should easily satisfy the requirements outlined for a phase-separation device. The minimum cooling-gas requirement was found to be 0.5 to 1 scfm per bearing, resulting in a torque of less than 1 in.-oz. at 9200 rpm and approximately 20° K. N.E.A.

N63-17146 Aeronautical Research Council (Gt. Brit.)
THE CONSTRUCTION AND TESTING OF A LARGE AXIAL FLOW COMPRESSOR
R. Shaw and A. Lewkowicz London, HMSO, 1963 14 p 2 refs
(ARC-CP-620; supersedes ARC-23817) Available from HMSO: 2s 6d

The construction of a large, low-speed research compressor is described, together with some preliminary performance tests of a single-stage arrangement at various speeds. The stalled region was investigated at all speeds, but at one speed a fuller investigation under stalled condition was carried out. At the low speeds involved, an indication of stall cell frequency could be ascertained by observation of the static-pressure-manometer fluctuations. Author

N63-17207 National Aeronautics and Space Administration, Washington, D.C.
A SYSTEM APPROACH TO RELIABILITY TESTING

Catherine Dryden Hock [1962] 18 p 11 refs Presented at the 1962 Reliability and Statistical Methods in Ind. Course, U. of Calif., Los Angeles, Aug. 7, 1962
(NASA CR-50311) OTS: $1.60 ph, $0.80 mf

The system "goal" is expressed in terms of a lower reliability value or confidence limit, which one desires to exceed with high probability. This definition applies to the sub-tier element value as well. The problem now resolves itself into determining what the sub-tier element reliability confidence limits should be, so that they are related in a probabilistic sense to the system confidence limit for the reliability at a given system confidence level. Once these limits are defined, the component sample sizes for demonstrating system reliability can be developed. Test plans for the system as a whole in developing reliability demonstration and test plans for components are presented. A general approach for developing component test plans based on the system model is given. N.E.A.

N63-17220 Aerojet-General Corp. Power Equipment Div., Azusa, Calif.
MERCURY CORROSION LOOP TESTING PROGRAM [Third] Quarterly Report, Apr. 1-June 30, 1962
Aug. 6, 1962 21 p
(NASA Contract NAS3-1925)
(NASA CR-50341; Rept. 0584-04-3) OTS: $2.60 ph, $0.83 mf

Operation of the first of ten loops to be tested was begun, and a second loop was fabricated. Tubing made of special alloys was procured for the fabrication of additional loops. Author

N63-17223 Aerojet-General Corp. Power Equipment Div., Azusa, Calif.
MERCURY CORROSION LOOP TESTING PROGRAM [Fourth] Quarterly Report, July 1-Sept. 30, 1962
Oct. 26, 1962 26 p
(NASA Contract NAS3-1925)
(Rept. 0584-04-4; NASA-CR-50342) OTS: $2.60 ph, $0.98 mf

Operation and modification of the first of the ten loops was continued. Author

N63-17245 Atomics International, Canoga Park, Calif.
THEORY, DESIGN, AND PERFORMANCE OF HELICAL-ROTOR, ELECTROMAGNETIC PUMP
R. S. Baker [Feb. 1, 1963] 124 p 24 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7455) OTS: $2.50

A new type of pump—the helical-rotor electromagnetic pump—has been developed over a five-year period. This pump has no seals, no moving parts in the liquid-metal stream, is capable of low net positive-suction operation without cavitation, can be mounted in any position, and is easy to control. A magnetic field set up by direct current flowing in windings on a rotor carrying skewed (helical) poles acts as the impeller. The liquid is confined to an annular space between two stainless steel cylinders. A flow rate of 2200 gpm at a pressure of 34 psi and an efficiency of 26% was obtained when pumping sodium at a stream temperature of 600° F. The rotor winding current was 25 amperes at 175 volts d.c. The pump has operated over 1000 hours without loss of performance. Author

N63-17267 McDonnell Aircraft Corp., St. Louis, Mo.
DESIGN RELIABILITY MEASUREMENT AND EVALUATION
William T. Sumerlin *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 37–44 5 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Reliability measurement by data collection and evaluation is considered. Parameters are defined and restrictions established. Reliability estimation of subsystems and parts as a preliminary to system estimation is reviewed, and rules are established. Confidence levels of subsystems and parts versus combined system are analyzed. Estimation planning is discussed. Tests planned for accept–reject reliability decision are very briefly considered. Author

N63-17268 Operational Test and Evaluation Force, Norfolk, Va.
SERVICE EVALUATION OF WEAPONS SYSTEM RELIABILITY
Mark W. Woods *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 45–48 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The environmental test program employed by the Navy to secure reliable missile and other weapons systems is summarized. The role of the commander of the operational test and evaluation force (COMOPTEVFOR) in the debugging and reliability testing of weapons systems and their components is discussed and the difficulties of obtaining accurate, valuable test-data at sea are enumerated. D.E.R.

N63-17269 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RELIABILITY TECHNIQUES IN PRODUCTION
Benjamin Louis Lubelsky *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 49–50 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

"Reliability" activities in this report include all special functions devoted principally to enhancing total product quality—and those functions known as quality control and/or inspection are, of course, of major importance in production areas. In addition, while the reliability engineering activity has largely been identified with the design activities, the production of reliable hardware in conformance with approved engineering designs is also a reliability engineering area of effort. Author

N63-17270 Air Force Systems Command, Andrews AFB, Md.
ECONOMIC CONSIDERATIONS OF RELIABILITY
Floyd E. Wenger *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 51–56 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The savings accrued by using reliable systems and the economic benefits to be derived from adequate reliability testing are discussed. It is pointed out that although a system or part that has been proven by exhaustive reliability testing may cost more initially, the longer life and more stable performance of the instrument will result in more valuable savings in the long run. Examples of costs per reliability level are given to illustrate the economic feasibility of developing reliable equipment. Three viewpoints on the economics of reliability programs are presented: (1) considering monetary values exclusively, assuming a ten-year equipment lifetime, (2) considering the repair time factor and safety of use, (3) putting a value on reliability based on cost per hour of operation. D.E.R.

N63-17271 Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C.
RELIABILITY RESEARCH NEEDS
Elidio J. Nucci *In its* [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 57–59 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Experience in the application of techniques developed through research in reliability has revealed gaps in the technology, and areas in which present techniques should be refined or the technology extended. These deficiencies, representing needs in reliability research, are enumerated, and priorities are suggested for some. Author

N63-17286 General Electric Co. Light Military Electronics Dept., Utica, N.Y.
RELIABILITY EVALUATION AND ENVIRONMENTAL TESTING OF PRINTED-WIRING-BOARD SOLDER JOINTS
Mark L. Hinkle *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 265–283 5 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

A series of reliability tests of solder (tin, lead; 60-40) joints on printed-wiring boards has been conducted. The discussion presents only a few highlights of this testing and evaluation. In particular, the results and conclusions are given from an extensive test configuration that evaluated the effect on solder-joint reliability of some eight different factors. These results have provided definitive quantitative solder-joint failure rates upon which can be based availability-cost tradeoffs and preferred printed-wiring-board solder-joint configurations for ultrahigh reliability, even with high rates of temperature cycling and temperatures of 100° C. Author

N63-17288 Motorola, Inc. Military Electronics Div., Scottsdale, Ariz.
THE SPECIFICATION AND ASSURANCE OF LARGE MTBF'S TYPICAL OF SPACECRAFT ELECTRONIC EQUIPMENTS
Clifford C. Petersen *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 297–301 12 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The initially stated question relative to large MTBF's typical of spacecraft missions was, "How is reliability best specified and assured?" We have answered as follows: Assurance by means of life-test demonstration is the best kind of assurance even if such tests must be curtailed; several ways of making long tests practicable are suggested; some often-neglected specification requirements are discussed; and the implications of a decreasing failure rate and longer burn-in of equipment are explored. Author

N63-17293 Bell Telephone Labs., Inc., Whippany, N.J.
SYSTEM RELIABILITY EVALUATION TESTING
George Anthony Schiehser *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 363–365 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

An adequate system is defined and the three factors that determine whether or not a given system is adequate are discussed. These factors are: (1) the use of lowest failure-rate components; (2) design to make use of this inherent low failure rate; and (3) design for an availability of 99%. System reliability testing is then applied to the system to determine if the criteria set by these factors are met. The problems of error detection in reliability testing are discussed and the objectives of such testing are pointed out. D.E.R.

N63-17295 Bell Telephone Labs., Inc., Whippany, N.J.
SYSTEM RELIABILITY EVALUATION FROM SUCCESS AND FAILURE DATA
Richard Hammell *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D. C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 381–386 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Reliability engineering is discussed. Conclusions drawn are that: (1) Reliability is in transition between art and science. Greater efforts are needed to mix it with other disciplines. (2) Less reticence about success in reliability testing will aid in increasing understanding of project people. (3) Success and failure data must both be used as tools to further research. (4) Failure analysis in early design stages pays the greatest dividends. (5) All troubles, including field use, should be reported for all phases of a system's life. (6) Analysis of in-use failures is vital to system reliability. (7) The tools of design should be examined in the case of failure. (8) Trouble data collection is not easy. (9) Component failure analysis must go beyond the study of the component. (10) Effort expanded in failure analysis should be in proportion to the effect of trouble on the system's mission. D.E.R.

N63-17296 Raytheon Co., Lexington, Mass.
A SURVEY OF TECHNIQUES FOR ANALYSIS AND PREDICTION OF EQUIPMENT RELIABILITY
Richard M. Jacobs (Sylvania Electric Products, Inc.) and H. Elmore Blanton *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 387–400 170 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper presents a brief synopsis of representative techniques that are used in the analysis and prediction of equipment reliability during the design phase. In particular, attention is directed to: (1) techniques commonly employed for the prediction of circuit or module reliability, given part reliability, circuit configuration, and environment; (2) techniques commonly employed for the prediction of equipment (or systems) reliability, given module reliability, equipment configuration, and operational and environmental requirements; and (3) advanced statistical techniques which are useful under certain conditions to supplement those techniques previously mentioned. Author

N63-17353 Naval Air Development Center, Johnsville, Pa.
THIN FILM MICROMINIATURIZATION AT NAVAIRDEVCEN
P. N. Drautman *In* Office of Naval Res., Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 14–21 (See N63-17351 15-09) OTS: $5.00

Work on thin-film microminiaturization at NAVAIRDEVCEN has covered the following: the formulation of techniques to achieve fairly consistent results with thin-film conductors, resistors and capacitors; work on ceramic substrates using glass microslides cleaned with alconox and degreased with isopropyl alcohol and a glow discharge; work on circuit cryotron units; evaluation of ultrasonic welding; and work with nichrome resistors and cermets. J.R.C.

N63-17354 Naval Avionics Facility, Indianapolis, Ind.
NAFI LABORATORY PROGRESS REPORT ON MICROELECTRONICS

Noel W. Scott *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 22–33 6 refs (See N63-17351 15-09) OTS: $5.00

This report briefly describes NAFI laboratory progress in the making of masks, substrates, conductors, resistors, capacitors, and active components. J.R.C.

N63-17364 International Business Machines Corp., Kingston, N.Y.
MATERIALS AND PROCESSES FOR THE PRODUCTION OF FILM ELECTRONIC CIRCUITRY
F. L. Stutz, W. Himes, and B. F. Stout *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 161–188 13 refs (See N63-17351 15-09) OTS: $5.00
(Contracts DA-36-039-SC-84547; DA-36-039-SC-87246; and N163-9142(x))

This paper describes the vacuum deposition of thin-film microcircuits. The fabrication of conductors, insulators, and resistors is also described as well as pilot-production vacuum equipment developed for the deposition of RC-networks. The production equipment consists of four modular vacuum chambers operated as an in-line unit and equipped with mechanisms for transporting heated substrates and changing masks. The accurate registration of masks and substrates, the automatic control of evaporation sources and deposition cycles, and appropriate instrumentation promise constant output and high yield. The equipment utilizes a 3 3/4- by 5 3/16-inch substrate area. Projected yields of presently used circuitry allow for the production of approximately 7500 circuits per shift. Author

N63-17367 Sylvania Electronic Systems, Waltham, Mass.
ADVANCED INTEGRATED PASSIVE AND ACTIVE THIN FILM TECHNOLOGY
Gerald J. Selvin *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 206–218 (See N63-17351 15-09) OTS: $5.00
(Contract NObsr-87633)

The present status of Sylvania's Microelectronics activities is outlined and future results are predicted. The size reduction brought about by thin-film microcircuitry is illustrated with a typical audio amplifier circuit which showed a reduction from 2.0 in. in June 1962 to 0.35 in. in January 1963. A further size reduction to 0.100 in. is predicted for 1964. R.C.M.

N63-17369 General Electric Co., Syracuse, N.Y.
RELIABILITY REQUIREMENTS IN MICROELECTRONIC SYSTEMS
J. J. Suran *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 230–253 (See N63-17351 15-09) OTS: $5.00
(Contracts DA-36-039-SC-87466 and N62269-1335)

The factors which influence reliability in microelectronic systems are discussed and possible areas for improving reliability are outlined. The areas discussed include: circuit complexity, operating temperature, standardization, and power dissipation. R.C.M.

N63-17370 Lear Siegler, Inc., Santa Monica, Calif.
THIN FILM APPROACH TO COMPLEX ELECTRONIC SYSTEMS
David Moore *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 254–272 (See N63-17351 15-09) OTS: $5.00

The status of the thin-film microcircuitry art is discussed, with particular reference to the use of microcircuits in complex electronic systems. The thin-film approach to microcircuitry is shown to offer the following: latitude in circuit design, deposition of accurate and stable components, selection of any desired active elements, freedom in choice of substrate size, and economy and ease of fabrication. R.C.M.

N63-17420 Sperry Gyroscope Co., Great Neck, N.Y.
MANUAL OF METAL-TO-CERAMIC SEALING TECHNIQUES
C. W. Johnson and E. W. Cheatham May 1963 54 p
(Contract AF 30(602)-2371)
(NA-27-0001)

The organization of this manual on metal-to-ceramic sealing techniques is patterned after the normal work fow, i.e., from raw materials to finished products: (1) selection of raw materials, (2) seal design, (3) parts preparation and metallizing, (4) fixtures and assembly, (5) brazing, (6) control testing, (7) failure and analysis. N.E.A.

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-16999 Nuclear Metals, Inc., Concord, Mass.
BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM [Interim Report, 1 Apr. 1960–30 Sept. 1961]
S. H. Gelles Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 225 p 4 refs
(Contract AF 33(616)-7065)
(ASD-TDR-62-509, Vol. II)

The aim of this program is to make beryllium more useful as an Air Force structural material. The program was divided into eleven major efforts. Detailed abstracts of each program are presented in their respective sections. In addition, work contemplated for a future program is described in a separate section. Author

N63-17000 Chance Vought Corp. Vought Aeronautics Div., Dallas, Tex.
DEVELOPMENT OF A NICKEL BASE ALLOY SHEET FOR HIGH TEMPERATURE APPLICATION [Final Report, 15 Mar. 1961–15 July 1962]
H. Greenewald, Jr., and T. J. Riley Wright-Patterson AFB, Ohio, Directorate of Materials and Processes Apr. 1963 161 p 9 refs
(Contract AF 33(616)-7999)
(ASD-TDR-62-869)

The objective of this work was to develop 15- to 30-mil nickel-alloy sheet having 50,000-psi tensile strength at 1900° F, good corrosion (oxidation) resistance, and good ductility. This objective was essentially attained by developing a new process of directly rolling thin cast slabs of nickel-base alloy into sheet

on a specially designed, rigid rolling mill. The two starting alloy compositions were Inco 713c, developed by International Nickel Co., and the TaZ8 alloy developed by Lewis Research Center of NASA. Of the new experimental compositions, TaZ8 alloy and No. 429 alloy have 1900° F tensile strengths exceeding 50,000 psi at 1900° F in the as-cast condition. Inco 713c has a tensile strength of about 40,000 psi in the as-cast condition. Procedures were developed on the rigid mill for hot rolling both Inco 713c and TaZ8 alloy into 15- to 30-mil sheet. Heat-treatment procedures were developed for both alloys which enabled them to meet the desired strength properties. The maximum room-temperature ductility obtained in rolled and heat treated Inco 713c sheet was 20% elongation compared to a maximum of 5% elongation for the rolled TaZ8 alloy. The good room-temperature ductility of hot-rolled Inco 713c was further indicated by the fact that this hot-rolled sheet was cold rolled from 20 mil down to 3 1/2-mil foil. The oxidation resistance of TaZ8 alloy is adequate for limited periods of time at 1900° F; that of No. 429 alloy is substantially better; and that of Inco 713c is best of the three. Author

N63-17018 Colorado School of Mines Research Foundation, Inc., Golden

IMPROVED OXIDATION RESISTANCE OF MOLYBDENUM BY ALLOYING WITH RARE EARTH AND OTHER SELECTED METALS Final Report, June 8, 1955- Oct. 31, 1961

Wilbur J. Guay May 17, 1963 53 p 4 refs

(Contract NORd-16136)

The choice of a suitable alloying element for selective oxidation in a molybdenum base alloy was narrowed to hafnium. The principal investigations were carried out by preoxidizing the active component of the alloy in a hydrogen or helium atmosphere containing a partial pressure of oxygen, which was below the decomposition pressure of molybdenum dioxide. This treatment resulted in internal oxidation of the active component. Two practical results have emerged from these internal oxidation experiments. First, an internally oxidized specimen can be exposed to air at 725° C resulting in volatilization of the MoO_3 in the subscale to leave a coating of hafnium dioxide on the surface of the specimen. Secondly, the internal oxidation data can be used to calculate the diffusion coefficients of the active component in the alloy and of oxygen in the subscale. Knowledge of these parameters can then be used to predict the optimum conditions of temperature, partial pressure of oxygen, and alloy composition for external scale formation, a very desirable situation for achieving oxidation resistance. Author

N63-17022 Watertown Arsenal Labs., Mass.

AMPEROMETRIC TITRATIONS. I. DETERMINATION OF TRACE AMOUNTS OF VANADIUM IN STEELS AND CAST IRONS

Frederick P. Valente and George H. Carey Mar. 1963 22 p 5 refs

(WAL-TR-823.3/1) OTS: $0.50

An amperometric titration method has been developed for the determination of trace amounts of vanadium in steels and cast irons. This method does not require chemical separations, except in the case when more than 3 percent chromium is present, and may be used on the solution remaining from a routine chromium determination by visual titration. Author

N63-17070 Oak Ridge National Lab., Tenn.

INVESTIGATION OF THE WETTABILITY OF VARIOUS PURE METHODS AND ALLOYS ON BERYLLIUM

Ralph Gerald Gilliland (M.S. Thesis - Tenn. U.) June 13, 1963 97 p 37 refs

(Contract W-7405-eng-26)

(ORNL-3438)

The wetting behavior of the following is discussed: liquid silver, gold, germanium, aluminum, copper, palladium–2.1 weight percent beryllium, zirconium–5 weight percent beryllium, and titanium–6 weight percent beryllium on the surface of solid beryllium. In general, the wetting of these metals was investigated at 50° and 100° C above their melting points in argon and in vacuum. The general experimental method employed the use of sessile-drop techniques for the evaluation of wettability and the associated calculations. Interfacial contact angles between drop and solid measurements for various metals as a function of time, temperature, and atmosphere indicated that the wetting of beryllium increases with increasing temperature. Metallographic examination of wetting samples tested showed that only aluminum, zirconium–5 weight percent beryllium, and titanium–6 weight percent beryllium produced little or no alloying with beryllium. Calculated surface tension properties of those alloy systems found to produce little or no beryllium reaction are presented. Calculations are presented for the work of adhesion and the coefficient of spreading for aluminum, zirconium–5 weight percent beryllium, and titanium–6 weight percent beryllium. These data indicated that titanium–6 weight percent beryllium had the best overall wetting characteristics. N.E.A.

N63-17076 General Electric Co. Space Sciences Lab., King of Prussia, Pa.

HIGH TEMPERATURE VAPORIZATION STUDIES USING A RECORDING MICROBALANCE AND ELECTRON BOMBARDMENT HEATING. I. VAPOR PRESSURE OF SILVER. II. VAPOR PRESSURE OF PALLADIUM

Peter D. Zavitsanos Jan. 1963 29 p 8 refs

(Contract AF 04(694)-222)

(R63SD06)

A method has been developed for studying the equilibrium vapor pressure of high-temperature inorganic materials. It consists of measuring the rate of vapor deposition on a target intercepting a known fraction of the total vapor flux effusing from the orifice of a Knudsen cell. Rates of effusion are obtained by continuously weighing the target; vapor pressures and the heats of vaporization are calculated. The experimental and theoretical techniques are described, and the results of the reinvestigation of the vapor pressure of silver metal at 1273° to 1563° K are given. It is shown that the observed vapor pressure and ΔH°_{298} are in excellent agreement with the best literature values. The vaporization of palladium was studied in the temperature range 1537° to 1841° K. A heat of vaporization at 298° K was calculated, $\Delta H^{\circ}_{298} = 89.8 \pm 0.9$ kcal/mole, and a b.p. of 3150° ±100° K was estimated. Author

N63-17131 Armour Research Foundation, Chicago, Ill.

AN INVESTIGATION OF METAL FIBER REINFORCED LEAD Quarterly Report, Jan. 1 to Mar. 31, 1963

H. Schwartzbart, John F. Rudy, N. Bredzs, and M. H. Zoiss Apr. 24, 1963 12 p

(ARF-B765-28)

Progress is reported on the development and evaluation of lead-base metal-fiber-reinforced soldering tape for the joining of metal parts and lead-base fiber-reinforced bearings. The lead-base product used in both the tape and the bearings was prepared by impregnating mild steel fibers with lead–tin alloys. I.v.L.

N63-17154 Rensselaer Polytechnic Inst., Troy, N.Y.
INTERNAL FRICTION BEHAVIOR OF AN ALUMINUM-ALUMINUM OXIDE SAP-TYPE ALLOY
G. S. Ansell and P. E. Arnold Repr. from Trans. Met. Soc. AIME, v. 221, Feb. 1961 2 p 6 refs
(NASA Grant NsG-38-60)

The relaxation behavior of an aluminum-aluminum oxide SAP-Type alloy in both the fine-grained as-extruded and coarse-grained recrystallized conditions was investigated. The damping characteristics of the alloy samples were determined using a torsional-pendulum device. The internal-friction constant was determined in the alloy samples over the temperature ranges from 343° to 923° K at frequencies of 0.9, 1.3, and 1.8 cycles per second. From these data, an activation energy of relaxation for each pair of frequencies was determined by comparing the temperature shift of the relaxation peak with frequencies between each of the test frequencies, assuming that an Arrhenius-type rate equation is applicable. The mean value of the activation energy was about 6 kcal per mole. It is proposed that the relaxation behavior observed is due to a similar effect as the activation energy for steady-state creep which may be characterized by the nucleation of dislocations from grain boundaries. N.E.A.

N63-17156 California U., Berkeley. Lawrence Radiation Lab
VAPORIZATION AND THERMODYNAMIC PROPERTIES OF ZINC OXIDE
Donald F. Anthrop (Ph.D. Thesis) May 1, 1963 46 p 18 refs
(Contract W-7405-eng-48)
(UCRL-10708) OTS: $1.00

The vaporization of zinc oxide has been investigated by (a) Knudsen weight-loss measurements, (b) mass spectrometric measurements of the vapors effusing from Knudsen cells containing either zinc oxide or a mixture of zinc and zinc oxide, and (c) measurements of the evaporation rates of zinc oxide in streams of helium and zinc vapors. Zinc oxide was found to vaporize by dissociation to zinc atoms and oxygen molecules only. The oxide sublimes congruently (i.e., to a vapor of the same overall composition as the solid) at a vapor of the same composition very close to the stoichiometric. From the measured ion currents of Zn^+ and O_2^+ during congruent sublimation, the relative efficiency of electron current production, σ_{O_2}/σ_{Zn}, is calculated to be 1.28. Limits for the dissociation energies of ZnO(g) and Zn_2O(g) are calculated to be D°_{298} (ZnO) $\leqslant$ 66 kcal and D°_{298} (Zn_2O) $\leqslant$ 127 kcal. The Knudsen effusion studies and mass spectrometer studies identify the main sublimation reaction as $ZnO(s) = Zn(g) + 1/2\ O_2$ (g) at pressures in excellent agreement with pressures calculated from independent thermochemical data for the free energy of formation of zinc oxide and the vaporization of zinc metal. Author

N63-17205 Rice U., Houston, Tex.
QUENCHED-IN RESISTIVITY IN DILUTE ALLOYS
R. M. Asimow [1962] 13 p 17 refs Submitted for Publication
(NASA Grant NsG-6-59)
(NASA CR-50210) OTS: $1.60 ph, $0.80 mf

The quenched-in resistivity of a dilute alloy is analyzed in terms of the contributions caused by vacancies and by changes in the short-range order. It is shown that the vacancy contribution varies in a linear fashion with solute concentration and the short-range order term as the square of the solute concentration. Depending on the temperature, concentration, and controlling physical parameters, either effect can predominate. The vacancy dependence on solute concentration is determined by the solute-vacancy interaction energy which can be evaluated from theory. The short-range order term depends on the solute-vacancy interaction and on the difference in resistivity increment between an isolated solute atom and a paired solute atom. Both these quantities may be positive or negative, leading to the explanation of a negative quenched-in resistivity which has been observed in the present work in the Au-Ag system and in the Au-In system. Author

N63-17213 Battelle Memorial Inst., Columbus, Ohio
THE EFFECT OF IMPURITIES AND STRUCTURE ON THE TENSILE TRANSITION TEMPERATURE OF CHROMIUM
B. C. Allen, D. J. Maykuth, and R. I. Jaffee Nov. 16, 1962 32 p 20 refs Submitted for Publication
(NASA Contract NASw-101)
(NASA CR-50094) OTS: $3.60 ph, $1.16 mf

Wrought unalloyed iodide chromium, containing 39 to 95 parts per million total interstitials, has a tensile transition temperature of −15° C. Recrystallizing at 1100° C causes the transition to rise to 90° to 390° C, depending on the purity, grain size, and cooling rate after annealing. At about the 100 ppm level, individual additions of carbon or nitrogen raise the transition of both wrought and recrystallized chromium by as much as 210° C, while oxygen has a lesser effect, and sulfur essentially no effect. High transition temperature are exhibited by recrystallized and quenched chromium, and appear to be associated with the amount and distribution of interstitials. The latter can be either in solid solution or in the form of precipitates within the grains or at the grain boundaries. Quench hardening in chromium is primarily caused by nitrogen. The hardness, recrystallization, and grain growth behavior of chromium with and without impurity additions were also investigated. Author

N63-17218 Battelle Memorial Inst., Columbus, Ohio
THE HARDNESS BEHAVIOR OF CHROMIUM ALLOYED WITH GROUP IV-A TO VIII TRANSITION METALS
B. C. Allen and R. I. Jaffee Dec. 19, 1962 41 p 37 refs Submitted for Publication
(NASA Contract NASw-101)
(NASA CR-50154) OTS: $4.60 ph, $1.43 mf

The room-temperature hardness of iodide chromium containing binary additions of Group IV-A to VIII metals (titanium, zirconium, hafnium, vanadium, columbium, tantalum, molybdenum, tungsten, manganese, rhenium, iron, nickel, cobalt, ruthenium, rhodium, palladium, osmium, iridium, platinum) up to 65 atomic percent was investigated. Five-gram buttons, as arc-melted or as melted and homogenized, all showed a hardness minimum as a function of alloy concentration below 1 percent. The initial softening amounted to as much as a 20 percent decrease and was followed by solid solution hardening. Explanations based on lowering of elastic modulus or changing the nature of grain boundaries by alloying were found to make a negligible contribution to the observed softening. Thermodynamic evidence suggests this behavior is caused by a reduction in interstitial solubility by alloying. Softening is then presumably brought about by agglomeration of interstitial precipitates into an overaged form. Group VII-A and VIII but not IV-A to VI-A additions to chromium at about the solid solubility limits tended to cause mechanical twinning about hardness impressions. Paralleling the situation in molybdenum and tungsten, increasing the average group number above 6 promotes mechanical twinning and suggests a decrease in twin boundary energy. Large solid-solution additions of rhenium to

chromium caused significant increases in hardness up to 1100° C. A characteristic hardness break was exhibited at about half the absolute solidus temperature. Author

N63-17251 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
MINUTES OF THE ANNUAL ATOMIC ENERGY COMMISSION WELDING CONFERENCE HELD IN SAN ANTONIO, TEXAS, OCTOBER 3-6, 1960
May 1963 271 p refs
(TID-7620 (Pt. 1)) OTS: $3.50

The speeches and discussions at the Atomic Energy Commission's conference on welding in radioactive environments are presented. Included are: zircaloy welding techniques for the plutonium recycle program and fabrication of the uranium dioxide fuel-element, fuel assembly fabrication of a gas-cooled reactor, automatic welding of Hanford aluminum-clad fuel elements, fabrication of welded vessel of the Sandia reactor, mechanical properties in wrought depleted uranium, radiation damage in steels, arc welding of Inconel for nuclear powerplants, joining problems, welding and brazing work reports, and stress and rupture investigations on welded metals. D.E.R.

N63-17263 Cornell U., Ithaca, N.Y.
ELECTRON SPIN RESONANCE STUDY OF PARTIALLY-REDUCED VANADIUM PENTOXIDE
J. L. Ragle Sept. 7, 1962 22 p 16 refs
(Contract AF 49(638)-191)

Single crystals of partially reduced vanadium pentoxide have been prepared in the form $Cu_xV_2O_5$ with $0 \leqq x \leqq 0.040$, and two types of paramagnetic species have been observed by electron spin resonance techniques at X- and K-band frequencies. Neither of these species is associated with copper (II). The X-ray powder spectra taken on the $Cu_xV_2O_5$ samples for x=0, 0.0058, and 0.0114 show no observable differences in the lattice parameters. It has been found that partial reduction, with or without crystallographic structure modification, may be introduced into vanadium pentoxide by fusion with Li_2O, Na_2O, Ag, and Cu. Data are given in terms of a spin Hamiltonian appropriate to an axially symmetric species with S (spin no.) = I/2. D.E.R.

N63-17264 Cornell U., Ithaca, N.Y.
ELECTRICAL AND MAGNETIC PROPERTIES OF POTASSIUM TUNGSTEN BRONZE AND RUBIDIUM TUNGSTEN BRONZE
M. J. Sienko and Sheila MacEnness Morehouse Sept. 20, 1962 21 p 31 refs
(Contract AF 49(638)-191)

Single crystal conductivities have been measured for $K_{0.40}WO_3$ and $Rb_{0.32}WO_3$ in the range 150° to 370° K. Carrier mobilities, which are somewhat higher than in the Li and Na tungsten bronzes, closely follow a $T \sinh^2 (\theta/2T)$ dependence. Calculations on the basis of the theory of Howarth and Sondheimer strongly support the assumption that the thermal part of the carrier mobility in the tungsten bronzes is primarily determined by polar scattering from optical mode lattice vibrations. Magnetic susceptibilities have also been measured at room temperature for $Rb_{0.26}WO_3$ and $K_{0.23-0.45}WO_3$. Results are predicted by the Pauli-Peierls theory for quasi-free electrons. Author

N63-17304 California U., Berkeley
A FUNDAMENTAL STUDY OF THE VARIABLES ASSOCIATED WITH THE MIXING OF CERAMIC RAW MATERIALS [Final Report, Feb. 1961-July 1962]
D. W. Fuerstenau, R. M. Fulrath, and J. A. Pask Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 40 p 10 refs
(Contract AF 33(616)-7763)
(ASD-TDR-62-732)

This summary report presents the progress completed on the investigation of the mixing and sintering characteristics of Al_2O_3 and MgO particles. Separate interrelated areas of research have been investigated which include particle preparation, dry and wet mixing, and the sintering behavior of Al_2O_3 and MgO. The techniques of particle reduction and analysis of particle-size distribution have been investigated by determining the variables which affect the resulting particles. Emphasis has been placed on control conditions for a jet pulverizer. Variables encountered in the dry-mixing operation have been found to be the mixer design, loading methods, and sampling methods. The basic mechanisms and the characteristics of the reaction between MgO and Al_2O_3 have been studied with single crystals. The understanding of the fundamentals of the reaction has enabled the establishment of optimum sintering conditions. Some of the properties of sintered compacts due to varied sintering conditions have been determined. Author

N63-17332 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. EVALUATION OF LONG TERM GAS CORROSION OF HEAT RESISTANT ALLOYS FOR USE AS GAS-COOLED REACTOR FUEL CLADDING
J. S. Brunhouse, and G. W. Titus Apr. 1963 118 p 16 refs
(Contract AT(10-1)-880)
(IDO-28605) OTS: $2.25

Seven nickel-based alloys and one austenitic stainless-steel alloy were tested for periods up to 10,000 hr at 1750° F and up to 4,000 hr at 1850° F in the ML-1 reference coolant (99.5 vol% N_2 + 0.5 vol% O_2) and air to evaluate the materials and to provide design data for the selection of the fuel cladding for the ML-1 nuclear reactor. Hastelloy X, Inconel 600, Inconel 702, Inconel 604, Hastelloy R-235, G-157, Nichrome V, Nichrome V-Cb and AISI Type 310 stainless steel were examined for gas-corrosion effects and internal microstructural changes after 1,000, 2500, 5000, 7500, and 10,000 hr exposure. Samples were evaluated by weight-change measurements, oxide-penetration measurements, tensile testing, and metallographic examination. X-ray diffraction, X-ray fluorescence, and electron-microscope analyses were performed primarily on Hastelloy X. The results showed that Hastelloy X has excellent oxidation and nitriding resistance at 1750° F, and this material is recommended for use as cladding for the ML-1 fuel elements. Author

N63-17340 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INVESTIGATION OF MECHANICAL PROPERTIES AND METALLURGICAL CHARACTERISTICS OF A METALLIC CHROMIUM AND MAGNESIUM OXIDE COMPOSITE
Charles R. Manning, Jr., and Dick M. Royster Washington, NASA, June 1963 45 p 7 refs
(NASA TN D-1785) OTS: $1.25

An experimental investigation has been made to evaluate an uncoated, thin, composite sheet material, containing metallic chromium and magnesium oxide, for aerospace applications in the temperature range where coated refractory metals also

are being considered. The evaluation consisted of mechanical-property tests, both at room and elevated temperatures up to 2600° F. The effect of preoxidation at various temperatures on the room-temperature properties is shown. Bend and tensile transition temperatures were also determined, and static oxidation tests were performed up to 2800° F. The metallurgical study included identification of the oxide films by X-ray analysis and also a study of the solid-state reactions taking place between the chromium and the ceramic material by the use of light and electron microscopy. Fabrication of the composite is discussed briefly. A description of the equipment and procedures utilized in performing the evaluation tests is included. Author

N63-17393 European Atomic Energy Community, Brussels (Belgium)
INVESTIGATION OF Zr ALLOYS WITH Nb and Sn: THEIR USE AS CLADDING MATERIALS IN WATER-COOLED REACTORS Final Report (UNTERSUCHUNG VON LEGIERUNGEN DES ZIRKONIUMS MIT NIOB UND ZINN IM HINBLICK AUF DEREN VERWENDUNG ALS HÜLLMATERIAL IN WASSERGEKUHLTEN KERNREAKTOREN)
W. Jung-Konig, H. Richter, J. C. Tverberg, P. Wincierz, and U. Zwicker Apr. 1963 98 p 28 refs
(Contract Euratom 047-61-4 RDD; Euratom-United States Agreement for Cooperation)
(EUR-86.d)
Available from Belgian American Bank and Trust Co., N.Y., Account No: 121.86: 125 Belg. fr.

The zirconium alloy ZrNb3Sn1, which has been found promising in its use as cladding material in water-cooled nuclear reactors, was tested more intensively. During the corrosion in high-temperature water (350° C) and steam (400° C) it gains a lower hydrogen uptake than is found in Zircaloy-2. The optimum temperature for heat treatment due to the results of corrosion tests and mechanical testing is 580 ±10° C. Cold work has no important influence on the corrosion attack. Author

N63-17427 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Third Quarterly Progress Report, Oct.-Dec. 1962
H. H. Klepfer et al Washington, AEC Div. of Tech. Inform., Jan. 1, 1963 62 p 5 refs
(Contract AT(04-3)-189)
(GEAP-4139) OTS: $1.50

The fabrication of thirty-one alloys chosen from the alloy field, their heat treatment, and the preparation of over 1800 test coupons from these alloys have been reported. A summary of the findings of the fabrication study and the final chemical analysis of each alloy are presented. The corrosion testing of these coupons at 300°, 400°, and 500° C has now reached the 1125-hr exposure weighing. Gross trends observed thus far are reported. Mechanical testing of all alloys as-fabricated has been completed. A mathematical model has been derived describing the room-temperature mechanical properties of the alloys in the chosen alloy field. The results of studies of the partitioning of alloying elements in the corrosion oxide film are presented. Progress on the study of oxygen diffusion in alloy-doped nonstoichiometric ZrO_2 is reported. Author

N63-17429 National Aeronautics and Space Administration, Washington, D.C.
NOTES ON LIQUID METAL STUDIES IN FRANCE AND GREAT BRITAIN
Leo F. Epstein (General Elec. Co., Pleasanton, Calif.) June 1963 19 p refs
(NASA Contract NASr-108)
(NASA TM X-884) OTS: $0.50

This document is a summary of observations made in laboratories engaged in liquid-metal work in Great Britain and France during the summer of 1962. Particular attention has been devoted in this effort to (1) presenting names and addresses of British and French workers in this field for the convenience of Americans who wish to communicate with foreign researchers in the same area and (2) calling attention to ideas and techniques which would appear to be of direct interest and concern to NASA and the U.S. program. Author

N63-17436 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Summary Report, Oct. 1, 1961 through Sept. 30, 1962
T. A. Trozera, J. L. White, and R. H. Chambers Washington, AEC Div. of Tech. Inform., Nov. 10, 1962 50 p 38 refs
(Contract AT(04-3)-167)
(GA-3585) OTS: $1.25

Research on the mechanical properties of reactor materials is reported in the following areas: (1) deformation mechanisms in bcc metals, (2) stored-energy release spectra in deformed metals, and (3) dislocation dynamics in bcc metals. N.E.A.

N63-17460 General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.
CORROSION MECHANISM OF ZIRCONIUM AND ITS ALLOYS – DIFFUSION OF OXYGEN IN ZIRCONIUM DIOXIDE
D. L. Douglass Washington, AEC Div. of Tech. Inform., July 27, 1962 27 p 24 refs
(Contract AT(04-3)-189)
(GEAP-3999) OTS: $0.75

The diffusion rate of oxygen in anion-deficient zirconia, $ZrO_{1.994}$, has been determined by the interface migration of stoichiometric oxide, and is represented by the equation

$$D = 0.055 \exp(-33{,}400 \pm 3100/RT).$$

A comparison was made with other processes which occur in the metal and the oxide. Excellent agreement was noted between activation energies of oxygen diffusion in $ZrO_{1.994}$ and those for parabolic or cubic oxidation in both air and water. It appears that oxygen diffusion in the oxide is rate-controlling during oxidation of the metal. The corrosion and oxidation behavior of zirconium and some alloys are discussed in terms of the oxide-defect structure and the electrical-conduction behavior in the oxide. A speculative mechanism for corrosion transition to linear rates was suggested on the basis of preferential oxidation of a grain-boundary metallic phase. The nature of this phase and of its formation and elimination are discussed. Author

N63-17462 Little (Arthur D.) Inc., Cambridge, Mass.
RADIATION CHARACTERISTICS OF METAL VAPORS [Interim Report, 15 Jan. 1962-30 Nov. 1962]
A. E. Wechsler and P. E. Glasser Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 63 p 24 refs
(Contract AF 33(657)-7974)
(ARL-63-37)

An experimental program is described in which semi-quantitative data on absorption of radiant energy by alkali metal vapors were obtained. The range of variables covered were: temperature, 250° to 600° C; sodium and potassium vapor pressure, 0 to 18 mm Hg; vapor path length, 4 1/2 and 8 1/2 inches; wavelength region, 4000 to 8300 Å. The results are reported in terms of the decrease in intensity of light passing through alkali metal vapors as functions of vapor pressure, temperature, and path length. Calculated absorption cross sections are in the order of 10^{-18} to 10^{-19} cm^2 for sodium and potassium vapor over the wavelength region studied. The absorption of radiation by alkali metal vapors has been shown to have an observable effect on the heat transfer in arc and plasma systems. Author

19 MATERIALS, NONMETALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-17012 Aerospace Information Div., Washington, D.C.
MECHANICAL TESTS OF PLASTICS
June 11, 1962 6 p 4 refs
(AID Rept. 62-77; AD-288749) OTS: $1.10 ph, $0.80 mf

Recent Soviet tests to determine the mechanical properties of plastics are summarized and the factors affecting the results of such tests are listed with comments made on each. Included are: deformation rate, sensitivity to stress concentrations, size and manufacturing factors, effect of alternate loads, ultimate strength, fracture and bending rates, tensile and compression strengths, elasticity, and load behavior (parameters of the creep and stress-rupture curves). D.E.R.

N63-17015 RAND Corp., Santa Monica, Calif.
MATERIAL REQUIREMENTS FOR BOUNDARY-LAYER STABILIZING COATINGS – WATER APPLICATION
M. O. Kramer Aug. 1962 33 p 4 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3018-PR; AD-282683)

Consideration of past experimental work shows that the structural material of stabilizing coatings requires primarily a low modulus of elasticity (best results were obtained at approximately 100 psi) combined with great resiliency, or low inherent damping. Natural rubber, which has been used in the past, is unsatisfactory, since its resiliency is poor at low moduli of elasticity. It is concluded that improved hydraulic performance of the known coating designs can be achieved by using a material with appreciably less inherent damping than rubber, but equal modulus of elasticity. Author

N63-17024 California U., Berkeley. Lawrence Radiation Lab.
CRYSTALLINE LUMINESCENCE OF CELL-NUCLEAR CHEMICALS UNDER IONIZING RADIATION
Richard Lawrence Lehman (Ph.D. Thesis) Mar. 14, 1963 86 p 76 refs
(Contract W-7405-eng-48)
(UCRL-10724) OTS: $2.00

An experimental study has been made of the delayed phosphorescence and thermoluminescence properties of 34 separate cell-nuclear chemicals exposed as crystalline powders to cobalt-60 rays at 77° K. In addition, the luminescence of the nucleic acid bases and related compounds was studied under irradiation with intense heavy-ion and electron beams. Under electron bombardment, the effects of ambient gases at various pressures have been examined at 77° and 295° K. The biological significance of these measurements is discussed. Author

N63-17033 Naval Research Lab., Washington, D.C.
MAXIMUM STRAINS IN THE RESIN OF FIBERGLASS COMPOSITES
J. A. Kies Mar. 26, 1962 15 p 2 refs
(NRL-5752) OTS: $0.50

A simple analysis has been made of models representing possible conditions in glass-fiber-reinforced plastics. This analysis shows that for strains imposed in a direction transverse to a set of windings, the ratio of tensile strain in the resin to the average measured strain can approach E_g/E_r as the resin content is decreased to the limit for filling the interstices, where E_g and E_r are Young's modulus for glass and resin, respectively. For shear strains, the maximum strain concentration in the resin can be as high as 0.7 G_g/G_r, where G_g and G_r are the shear moduli of glass and resin. Measured average strains in service are as high as two percent. The strain in the resin in a direction transverse to the fibers is correspondingly about 40 percent. No resin in ordinary structural use can stand this strain without cracking. Author

N63-17034 Aeronutronic, Newport Beach, Calif.
LUNAR SEISMOMETER CAPSULE COLD IMPACT LIMITER Final Report
E. S. de Mocskonyi Dec. 17, 1962 21 p 7 refs
(LC(b)-417)

Sample tests were performed to determine the low-temperature compressive strength and energy-absorption capability of balsa wood and the low-temperature tensile and flexural properties of the skin. A total of 100 balsa compression samples were tested, 20 each at temperatures of 74°, 49°, 30°, 10°, and −15° F. Balsa compressive strength and energy absorption were found to be unaffected by temperature in the region 74° to 30° F, and to be uniformly higher by about 25% for temperatures of 10° and −15° F. Fifty skin-sample tests were performed, five each for flexure test and for tensile test, at approximately the same temperatures used in the balsa tests. Flexibility and ultimate load in flexure were found to be independent of temperature down to 50° F, but to change rapidly with further reduction in temperature. At −15° F, the flexibility is reduced, and the ultimate stress in flexure is increased by a factor of approximately five. Ultimate tensile strength at −15° F is increased about 60% over its value of 68° F. Three full-scale impact limiter system tests were performed using standard limiters, dummy survival capsules, and the Hygee impact-test techniques previously developed. The test assemblies were thrown at a velocity of 180 ft/sec with normal (90°) impact upon a plane hard surface. One limiter was conditioned at 10°, one at 0°, and one at −15° F. The deceleration strokes and impact footprints of the three limiters were identical and uniformly smaller than the characteristic results for 'warm' limiters. Calculations, based upon an idealized model of limiter dynamics, indicate that the energy

absorption capability and peak deceleration experienced by these limiters were both about 25% higher than the levels previously established by test of 'warm' limiters. Author

N63-17066 Naval Propellant Plant, Indian Head, Md.
SOME CONSIDERATIONS ON PLASTIC MATERIALS FOR USE AS SAFETY CONTAINERS
Martin F. Zimmer and Leo K. Asaoka Apr. 15, 1963 28 p 12 refs
(Tech. Rept. 130; NavWeps-8030)

Developmental studies were made with polyurethane containers. The effects of material properties, shape and size of both inner vials and containers, and the shock attenuation of the container material were investigated. Various materials were evaluated as possible candidates for fabricating the containers. Polyethylene containers, to safely hold comparatively large loads of explosive materials, have been developed and investigated. A 10-cm-diameter container can easily withstand the explosion of 15 g of nitroglycerin, and a 32-cm-diameter container can withstand an explosion of 500 g of nitroglycerin. Author

N63-17169 Cryogenic Engineering Lab., National Bureau of Standards, Boulder, Colo.
AN EQUATION OF STATE FOR CALCULATING THE THERMODYNAMIC PROPERTIES OF HELIUM AT LOW TEMPERATURES
R. D. Mc Carty and R. B. Stewart Repr. from Intern. Res. on Thermodynamic and Transport Properties by the American Soc. of Mechanical Eng. [1962] p 107–117 21 refs Presented at the Second Symp. on Thermophysical Properties, Princeton U., Jan. 24–26, 1962
(NASA Order R-45)
(NASA CR-50156; R-229)

A new equation-of-state for helium gas with six adjustable constants is presented. This relation is adequate for the representation of the P-V-T data and for the calculation of the entropy and enthalpy for a range of temperatures from 20° to 300° K, with pressures to 100 atm. A comparison of calculated volumes with the original data indicates an average arithmetic deviation of 0.07 percent and maximum deviations of 0.5 percent. A comparison of calculated pressures with original data indicates about the same average and maximum deviations. A temperature-entropy chart and a compressibility factor chart have been prepared from values calculated by this equation-of-state. Values of density, enthalpy, and entropy are tabulated, with temperature and pressure as independent arguments. Author

N63-17222 Emerson Electric Mfg. Co. Electronics and Avionics Div., St. Louis, Mo.
A COMPARISON OF THIN COATINGS OF PHENOLIC NYLON AND "THERMO-LAG" T-500 DURING EXPOSURE TO LOW CONVECTIVE HEAT FLUXES OF LONG DURATION
Nov. 21, 1962 101 p 16 refs
(NASA Contract NAS9-706)
(NASA CR-50340; Rept. 1414) OTS: $9.10 ph, $2.93 mf

The materials investigated were "Thermo-Lag" T-500, produced by Emerson Electric, and a low-density nylon-reinforced phenolic ablating formulation. The materials were applied to test models on an equivalent weight basis, the ablative material weights ranging from 0.03 to 0.18 pound per square foot. Tests were conducted in a Mach 3.200-kw air-stabilized arc jet. The test results showed "Thermo-Lag" T-500 to be superior material for the application, both thermally and mechanically. "Thermo-Lag" maintained the temperature of the substrate steel at or below its sublimation temperature of 530° F., while under identical conditions, application weights, and exposure durations, the phenolic nylon coating permitted temperatures to approach 900° F. At a heat flux of 30 Btu/ft^2 sec and an enthalpy of 3500 Btu/lb, the "Thermo-Lag" maintained original model configuration and formed an essentially nonreceding debris matrix in the stagnation region. The phenolic nylon models, under identical conditions, were subject to major configuration change. Cracking and spalling of the phenolic nylon coating material was observed during certain of the tests. Author

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-16997 RAND Corp., Santa Monica, Calif.
THE COMPOSITE SIMPLEX ALGORITHM: NOTES ON LINEAR PROGRAMMING AND EXTENSIONS – PART 64
Philip Wolfe Apr. 1963 44 p 11 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3579-PR)

This memorandum discusses in some detail the process of finding a feasible solution of a linear programing problem by means of the simplex method. It is shown how certain rules regarding the details of the process result in a procedure called the "composite" algorithm, presently used in several linear programing computer routines. Experimental evidence for the efficiency of the procedure is given. Author

N63-17065 University of Southern Calif. Engineering Center, Los Angeles
A SURVEY OF METHODS FOR DYNAMIC SYSTEM IDENTIFICATION AND RESEARCH IN OPTICAL COHERENCE Final Report
Robert B. Mc Ghee, Gregory O. Young, and Robert S. Macmillan Mar. 1963 89 p 52 refs
(Contract AF 49(638)-893)
(USCEC-97-101; EE-22)

The findings of the first phase of a study of the feasibility of utilizing computers in the determination of mathematical models for dynamic systems are summarized. Various types of models for this purpose have been reviewed. A new formulation of the general model inference problem, called the "parameter space method," is presented. A detailed study of the theory of optical coherence is conducted to obtain criteria for optimizing optical systems employing coherent sources and amplifiers, such as lasers. As part of a research program to determine the various effects of optical-system devices on the coherence properties of optical signals, spatial and temporal filters are studied. D.E.R.

N63-17067 General Electric Co. Re-entry Systems Dept., Philadelphia, Pa.
THE SUPERSONIC FLOW FIELD ABOUT A BODY OF REVOLUTION IN UNSTEADY MOTION
E. A. Brong and H. Rie Mar. 1963 73 p 13 refs
(Fundamentals Memo. 102)

A small perturbation scheme is applied to the governing equations and boundary conditions for the supersonic region of the shock layer about a body of revolution undergoing unsteady motion in pitch, yaw, and angle-of-attack. Equations are

prepared for a numerical solution of the perturbations in the flow-field parameters from their values in a steady, zero-yaw flow field. Equations are also provided for the numerical computation of the dynamic stability coefficients. Prior solution of the zero-yaw flow field, as well as knowledge of the flow-field perturbations along a "starting line," are necessary for the application of the present method. Author

N63-17069 Pennsylvania State U., University Park
TRANSIENT ANALYSIS OF OBLIQUE IMPACT Interim Technical Report No. 1
William Lawhead and Norman Davids Mar. 1, 1963 62 p 11 refs
(Contract DA-31-124-ARO(D)-67)

This report carries out an analysis of the propagation of stress waves from an oblique unit step pulse concentrated at a point on the upper surface of an infinite plate whose thickness is of the order of magnitude of a wavelength. The expansion method used by Mencher in his buried-source problem is employed to separate successively reflected waves of increasing time dealy. A problem of determination of a Laplace transform and its inversion is encountered, and is solved by inspection with use of Cagniards artiface. Stress expressions and sets of numerical principal-stress values are obtained for the stress state at points along the z-axis. The sets of numerical principal-stress values are for oblique angles-of-incidence of 30° and 60°. Stress surfaces are then drawn to illustrate the principal stress-state variation with time, and the jump discontinuity wave fronts signaling respective wave arrivals. Author

N63-17071 California U., Livermore. Lawrence Radiation Lab.
A HEATING MECHANISM FOR A PLASMA
Darly D. Reagan Apr. 11, 1963 12 p 6 refs
(Contract W-7405-eng-48)
(UCRL-7294) OTS: $0.50

A sinusoidal fluctuation in magnetic field can gradually heat a uniform plasma. This effect is discussed from the standpoint of Boltzmann's equation, including some effects of collisions, for frequencies which are low compared to plasma and cyclotron frequencies. An application is mentioned to the problem of an electron–ion plasma with radiation loss. Author

N63-17078 Weapons Research Establishment (Australia)
A NUMERICAL SOLUTION FOR THE CHARACTERISTIC IMPEDANCE OF SQUARE COAXIAL LINE BY DIGITAL COMPUTER Technical Note
H. E. Green Jan. 1963 20 p 14 refs
(EID-59)

This paper discusses the application to a digital computer of a method which has earlier been used for the solution of potential problems by analog means. It is shown how this approach may be extended to compute the capacity per unit-length of a uniform transmission line and hence its characteristic impedance. By way of illustration details of an extensive study of the square coaxial line, which has been made by this method, are given and the possible extension of this data to certain types of rectangular coaxial line is indicated. Comparison of the work with results obtained by earlier analyses is used to establish an estimate of the accuracy of the method. This is shown to be consistent with good modern day engineering practice. Author

N63-17081 Naval Weapons Lab. Computation and Analysis Lab., Dahlgren, Va.
THE PLOTTING OF MAPS ON A CRT PRINTER
A. V. Hershey June 1963 86 p 14 refs
(NWL-1844)

Files of map data have been recorded to cover the world, the United States, and the Potomac Area. A computing subroutine has been prepared to plot the map data on the Naval Ordnance Research Calculator. Author

N63-17090 Illinois U. Coordinated Science Lab., Urbana
AN OPTIMIZATION TECHNIQUE FOR PULSE WIDTH MODULATED SYSTEMS
Robert William Kafka May 1963 97 p 37 refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-163)

A procedure for the design of a controller to optimize a certain class of pulse-width modulated systems is presented. The process to be controlled is time-invariant, of arbitrary order, and excited by a sequence of pulses generated from information available at arbitrary sampling instants. Input information to the system is quite general and includes random and deterministic phenomena. Identification of the plant is accomplished using state variable notation and linear estimation techniques. Prediction of the future plant behavior is also performed with these techniques, and the controller is designed to optimize the predicted plant performance by minimizing a measure of the future system errors. The mechanized optimal control law, or controller program, develops the pulse to be applied at any sampling instant by specifying the pulse width and associated sign. The controller is not adaptive in the sense of redesign occurring as new information becomes available from the estimator. It does, however, accomplish the goal of optimization by deciding the form of the pulse-width actuating signal utilizing the future errors of the system. Author

N63-17091 Illinois U. Coordinated Science Lab., Urbana
ON DIRECT FIXED-TIME OPTIMIZATION OF INVERTIBLE SYSTEMS
Stephen James Kahne June 1963 70 p 28 refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-162)

A numerical technique for calculating the optimal control for a class of systems and constraints is described. Nonlinear, time-varying deterministic systems subject to hard-state-space and hard-control-space constraints are considered. Three numerical procedures are developed to perform the optimization. A technique for the minimization of a scalar function of a vector variable is described where the components of the vector are constrained by upper and lower bounds. This minimization procedure is incorporated in a method of constraint mapping which maps the state space constraints into the control space. To improve convergence properties of the optimization procedure, the notion of a pseudo performance index is introduced. Initial and final states may be partially or completely specified. Any unspecified initial- or final-state vector components are optimally selected. An iterative technique for the optimization is demonstrated which generally converges to a local minimum of the performance index. The method uses the direct approach to optimization, and is very efficient computationally. Examples of space-vehicle-trajectory-optimization problems are given. Author

N63-17100 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
THEORETICAL PERFORMANCE OF SELECTED FLUID INJECTANTS FOR THRUST VECTOR CONTROL
R. E. Walker and M. Shandor Nov. 1962 39 p 5 refs
(Contract NOw-62-0604-c)
(CM-1027)

A linearized model of fluid-injection thrust-vector control is developed and shown to be in good agreement with experimental data. It is used to predict performance of various fluid injectants (gas and liquid, inert and reactive) in conjunction with a hypothetical rocket. The results are discussed in detail. Author

N63-17103 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.
THE PEACEMAN-RACHFORD METHOD FOR SMALL MESH INCREMENTS
Willis H. Guilinger, Jr. Mar. 1963 81 p 17 refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-367) OTS: $2.00

Bounds are obtained for the accuracy of the Peaceman-Rachford iterative method that is applied to finite-difference approximations of certain two-dimensional elliptic and parabolic partial differential equations. The elliptic differential equation for bounds for second differences and approximation error bounds for variable mesh increments are examined; also the parabolic differential equation for approximation error bounds for equal mesh increments is examined. N.E.A.

N63-17118 Litton Systems, Inc. Data Systems Div., Waltham, Mass.
STATISTICAL INSTRUMENTATION STUDY Final Report
A. W. Crooke, W. B. Floyd, and A. H. Nuttall Mar. 14, 1963 93 p 11 refs
(Contract AF 30(602)-2663)
(RADC-TDR-63-136)

The choice between parallel processing of samples utilizing a general purpose computer and serial processing with a special purpose device hinges on (1) the availability of a computer, (2) the capability to feed data directly into the computer without intermediate storage, and (3) whether many small-scale probability analyses will be performed, or relatively few large-scale analyses. Consideration of (2) and (3) has led to implementation of the serial processing method on this project. Salient features of the serial processing breadboard are: (1) A rough estimate of an entire probability density function can be obtained quickly through the use of a coarse histogram cell structure. (2) Partial results (e.g., a portion of a probability density function) can be obtained quickly without having to go through a complete calculation. (3) Answers to practical problems of the form $Pr\ [\underline{x} \in R]$, where R may be a complicated region, can be obtained directly without going through the intermediate step of calculation $P_n(\underline{x})$. (4) Accuracy requirements can be translated to processing time with a fairly high degree of confidence. (5) Expansion or modification of the device to accommodate special requirements is readily implementable. A device described will provide answers to a large variety of statistical questions, if suitable modifications are made in the success region detector. Author

N63-17119 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE OBSERVATIONS OF THE EQUATORIAL IONOSPHERE
L. J. Blumle Washington, NASA, June 1963 11 p 16 refs
(NASA TN D-1756) OTS: $0.50

A method is presented for measuring total electron content by observing the Faraday effect on satellite beacon transmitters at a station located on the magnetic equator. This method is applied to data observed at Huancayo, Peru, between September 1961 and February 1962. The total electron content at the magnetic equator was found to have nearly a 10 to 1 diurnal variation with a maximum of 4×10^{17} electrons/m^2 near 1500 hours. Values of the thickness parameter $(\int Ndh)/N_{max}$ for the observational period show an anomalous increase around layer sunrise which is attributed to a departure from thermal equilibrium. Author

N63-17122 Aeronautical Research Council (Gt. Brit.)
UPWASH INTERFERENCE IN A RECTANGULAR WIND TUNNEL WITH CLOSED SIDE WALLS AND POROUS SLOTTED FLOOR AND ROOF
D. R. Holder London, HMSO, 1963 12 p 4 refs
(ARC-R&M-3322; previously issued as ARC-23784) Available from HMSO: 5s 6d

Solutions have been obtained from the upwash interference on two-dimensional airfoils, and small-span wings, in a rectangular wind tunnel with viscous flow through the slotted floor and roof. A discussion is included on the application of results to tests on wings of moderate span. Author

N63-17124 RIAS. Div. of Martin Co., Baltimore, Md.
TOPOLOGICALLY CONVEX SETS AND FIXED POINT THEORY
G. Stephen Jones Apr. 1963 24 p 4 refs
(NASA Contract NASr-103; Contracts AF 49(638)-382, DA-36-034-ORD-3514 RD, and Nonr-3693(00))
(NASA CR-50251; RIAS-TR-63-8) OTS: $2.60 ph, $0.92 mf

The main purpose is to identify a class of topologically convex sets and to apply this identification to the theory of fixed points. Several theorems and proofs concerning topologically convex sets are given. Application of theorems concerning topologically convex sets in the theory of fixed points is presented, e.g., an asymptotic fixed point theorem is established which is useful when investigating periodic systems in Banach space. N.E.A.

N63-17142 Naval Research Lab., Washington, D.C.
RANGE-ENERGY RELATIONS FOR PROTONS AND ELECTRONS IN Al, Si, AND SiO_2 Final Report
V. J. Linnenbom Sept. 28, 1962 15 p 11 refs
(NASA Order No. S-13991-G)
(NASA-CR-50325; NRL-5828)

Range-energy relationships for protons penetrating silicon and quartz are presented for the energy region 100 kev to 100 Mev. The range of protons in Si is obtained from range data in Al, corrected by the inverse mass stopping power ratio of the two elements. Low energy data (100 kev to 1 Mev) for Al are recalculated by graphical integration of the reciprocal mass stopping power curve. Ranges in Al for protons greater than 1 Mev in energy are taken from the literature. The data for SiO_2 are calculated from data on Si and gaseous O_2, based on Bragg's rule that the stopping power of a compound is equal to the sum of the contributions made by the individual atoms of the compound. To complete the picture, range-energy relationships for electrons are also presented. Author

N63-17143 National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
THE EXCITATION OF ELECTROACOUSTIC WAVES BY ANTENNAS IN THE IONOSPHERE
H. A. Whale Washington, NASA, June 1963 18 p 13 refs
(NASA TN D-1760) OTS: $0.50

Measurements of the impedance of an electrically short 7.75-mc antenna in the ionosphere indicate that power is absorbed by some mechanism additional to electromagnetic radiation. The importance of the radiation of energy as an electron-pressure (electroacoustic) wave generated near the antenna is discussed, and it is shown that the calculated power radiated by this mechanism agrees well with the observations. Author

N63-17145 Aeronautical Research Council (Gt. Brit.)
DETERMINATION OF ION DENSITY AND TEMPERATURE OF A WATER-STABILIZED ARC FROM OBSERVATIONS OF THE LINE PROFILES OF THE HYDROGEN LINES Hβ AND Hγ
A. F. Metherell (Natl. Phys. Lab.), P. S. Pusey and K. C. Lapworth London, HMSO, 1963 24 p 10 refs
(ARC-CP-614; previously issued as NPL/AERO/428; ARC-23162) Available from HMSO: 3s 9d

The ion density in the plasma of a water-stabilized arc has been determined by applying Holtsmark's theory to the observed profiles of Hβ and Hγ. The ion density so determined was used to compute the temperature of the arc. Author

N63-17175 Weapons Research Establishment (Australia)
THE OPTIMUM SMOOTHING OF TRAJECTORY DATA WITH SPECIAL REFERENCE TO THE EPS 16 RADAR Technical Note
H. H. Evans Jan. 1963 37 p 11 refs
(SAD-103)

Optimum weighting functions are derived for estimating polynomial signals in the presence of noise of known characteristics, using established techniques. The weighting functions are evaluated for signals adequately represented by first, second or third degree polynomials in the smoothing interval. The assumed noise characteristics are of the type expected in the output from FPS 16 Radars. The method of applying these smoothing functions is given together with the expected variances of the smoothed estimates of the signals and their derivatives. Author

N63-17176 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
NORMAL SHOCK PARAMETERS FOR THE MARTIAN ATMOSPHERE
F. Bosworth, C. Cook, L. Gilbert, and S. Scala Jan. 30, 1963 47 p 28 refs
(R63SD12)

Normal shock wave and stagnation point solutions are presented for two limiting models of the Martian atmosphere, covering a range of flight speeds from 6,000 to 25,000 feet per second, and a range of altitudes from zero to 500,000 feet. Curves of dimensionless pressure, temperature, and density of the shocked gas are presented as functions of flight speed for constant altitudes. Author

N63-17178 Atomic Energy of Canada Ltd., Chalk River
THE CALCULATION OF THERMAL NEUTRON LEAKAGE IN A HEXAGONAL LATTICE
J. D. Stewart and D. C. Self Apr. 1963 23 p 3 refs
(CRRP-1147; AECL-1752) Available from Scientific Document Distribution Office AEC of Canada Ltd., Chalk River, Ontario: $1.00

A general method of calculating the thermal neutron leakage perpendicular to the rods from or into a hexagonal lattice is reported, when the source q is distributed according to $\nabla^2 q + K^2 q = 0$, or $\nabla^2 q - K_t^2 q = 0$. The second equation corresponds to the spatial transient distribution in a two-group theory. The method of calculation is based on the matching of fluxes and currents at cell boundaries; the calculation was checked by making simplifying assumptions (non-absorbing moderator, line-sink rods) and then by computing the neutron leakage both by this method and by the microscopic-discrete method. Results of these check calculations are given. It is found that the thermal leakage coefficient (outleakage/K^2x absorption) decreases with K^2 and that the limiting value for $K^2 \rightarrow 0$ is less than L^2 by about the same amount as for a parallel-plate lattice. N.E.A.

N63-17201 Southwest Center for Advanced Studies, Dallas, Tex.
ON THE STABILITY OF A PLANE VORTEX SHEET WITH RESPECT TO THREE-DIMENSIONAL DISTURBANCES
John W. Miles (Australian Natl. U.) and J. A. Fejer Repr. from J. Fluid Mech., v. 15, pt. 3, 1963 p 335–336 5 refs
(NASA Grant NsG-269-62)
(NASA CR-50332)

The previously established criterion for the stability of a vortex sheet with respect to two-dimensional disturbances in a compressible fluid is extended to three-dimensional disturbances, and it is shown that disturbances travelling at sufficiently oblique angles with respect to the undisturbed flow are unstable. Slip-line instability downstream of a Mach reflexion is discussed briefly. Author

N63-17202 Stanford U., Calif.
A METHOD OF DISCUSSION OF THE ELASTIC STABILITY IN NON-LINEAR SNAP BUCKLING. (SNAP BUCKLING OF CIRCULAR PLATES DUE TO RAPID HEATING OR COOLING) Technical Report No. 5
Masuji Uemura Feb. 1963 30 p 9 refs
(NASA Grant NsG-93-60)
(NASA-CR-50243; SUDAER-145) OTS: $2.60 ph, $1.10 mf

In order to investigate the stability condition of certain equilibrium states existing in the nonlinear buckling phenomenon as a result of finite deformations, and in order to specify a reasonable deformation process, a method of analysis of the stability criterion in two-dimensional plates or shells is presented. This method is applied to a sample problem concerning the snap buckling of circular plates due to rapid heating or cooling, and is found to be of use especially when the Euler equation derived from the variational method is solved by the progressive approximation method. Since the effect of the temperature gradient through the thickness resulting from the rapid heating or cooling corresponds to the action of a pressure over the surface, it should be noted that a snap buckling may be induced by this effect, even if there is no initial deflection. Author

N63-17217 Rensselaer Polytechnic Inst., Troy, N.Y.
NONLINEAR GUIDANCE SYSTEM FOR DESCENT TRAJECTORIES
C. N. Shen [1962] 9 p 12 refs Submitted for Publication
(NASA Grant NsG-14-59)
(NASA CR-50215) OTS: $1.10 ph, $0.80 mf

The problem of providing a descent trajectory for a vehicle that enables it to make a soft landing is discussed, and the guidance requirements for such a maneuver are delineated. The equations of motion for such a vehicle are derived and the forces on the spacecraft are mathematically calculated, including the transverse specific force and the specific angular momentum, so that the craft can obtain zero transverse velocity and radial acceleration. The problem is solved for a vertical landing, inclined landing, and for a horizontal landing; and the characteristic root is found, proving that the angular and radial velocities would be zero if this trajectory is used. D.E.R.

N63-17228 Minneapolis-Honeywell Regulator Co. Military Products Group, Minn.
ADAPTIVE STATE VECTOR CONTROL. SECTION 4: THE THEORY OF TIME-OPTIMAL CONTROL OF LINEAR SYSTEMS
C. A. Harvey and E. B. Lee Apr. 15, 1962 36 p 14 refs
(NASA Contract NASr-27)
(NASA CR-50324; MH-MPG-1529-TR4) OTS: $3.60 ph, $1.28 mf

An open-loop time-optimal regulator problem is considered for plants that can be represented by linear differential or linear recurrence equations. The problem is treated in sufficient generality to encompass both single- and multiple-component regulator problems. Uniqueness theorems are proved in order to derive necessary and sufficient conditions that an optimal control must satisfy. Author

N63-17231 New York U. Coll. of Engineering, N.Y.
DETECTION OF SIGNALS IN COLORED NOISE
Bernard Harris May 1, 1962 39 p
(NASA Contract NAS5-408)
(NASA CR-50348; Tech. Memo. 25) OTS: $3.60 ph, $1.37 mf

The basic concepts of signal design and signal reception in the presence of channel interference caused by additive white gaussian noise are extended to include the case of additive nonwhite gaussian interference, i.e., that interference where the noise power per unit bandwidth is not the same at all frequencies. It is found that with nonwhite as with white noise, the correlation techniques are optimum, but the received signal is not correlated with the possible message signals, but with modified signals obtained from the characteristics of the message signals and the noise power spectrum. The integral equation for finding these signals is given and the properties of these signals are enumerated. The selected noise power spectrum is found to act as a weighting function that concentrates the signal power into a narrow range of frequencies. D.E.R.

N63-17232 Aberdeen Proving Ground. Ballistic Research Labs., Md.
ROUTINE FOR FINDING ROOTS OF POLYNOMIALS WITH REAL COEFFICIENTS
Tadeusz Leser Apr. 1963 17 p
(BRL-MEMO-1467)

A routine is developed that computes the real and the complex roots of polynomials with real coefficients up to the tenth degree. In case of an even polynomial, it computes its quadratic factors and solves each factor by the quadratic formula. In case of an odd polynomial, it computes one real root by locating it and refining by Newton's algorithm. Then it removes the computed root from the polynomial reducing its degree by one. The reduced polynomial is of even degree and is solved by quadratic factors. The routine fails when (a) the real roots are of even multiplicity, converging then to wrong values, (b) the real roots are of odd multiplicity, not converging at all, and (c) the polynomial is badly conditioned (very small changes in coefficients cause large changes in the values of the roots) converging then to wrong values. The routine is planned to compute frequencies in vibration problems which involve complex roots. Statistical evidence seems to indicate that only polynomials with real roots can be badly conditioned. If this were the case, the handicap (c) would be of minor importance. Author

N63-17241 Aeronautical Research Associates of Princeton, Inc., N.J.
THE FOUNDATIONS OF NON-EQUILIBRIUM STATISTICAL MECHANICS
Guido Sandri Apr. 1963 88 p 12 refs
(Contracts Nonr-3623(S-7) Phase I; AF 49(638)-1140; and AF 49(638)-1224; Proj. Squid)
(ARAP-49, Pt. I)

In this paper, a novel philosophy of irreversible dynamics is formulated. This philosophy stems from the fact that the kinetic equations available (Boltzmann, Landau, Bogolubov–Balescu–Lenard) are essentially exact and cannot be improved. That is, for kinetic gases (those whose behavior is characterized by that of one typical particle) these equations constitute closed, statistically complete knowledge. This thesis is demonstrated by using a technique that separates completely the different time components exhibited by the evolution of a gas when an appropriate parameter (characteristic of the regime in which the gas is found) is small. When statistical information about a gas is needed beyond that afforded by the knowledge of the motion of the average particle, a new asymptotic expansion of the Liouville equation must be devised. Thus, for example, the preponderance of three-body collisions demands knowledge of the evolution of the average pair of particles. For this situation, a pair-kinetic expansion is introduced. A hierarchy of increasingly more informative descriptions of a gas is thus envisaged. Author

N63-17242 Aeronautical Research Associates of Princeton, Inc., N.J.
THE FOUNDATIONS OF NON-EQUILIBRIUM STATISTICAL MECHANICS
Guido Sandri Apr. 1963 78 p 7 refs
(Contract Nonr-3623(S-7), Phase I; AF 49(638)-1140; AF 49(638)-1224; Proj. Squid)
(ARAP-49, Pt. II)

Discussion is continued of the kinetic expansions of the Liouville equation. The "superkinetic" expansions are introduced and discussed. Author

N63-17243 Aeronautical Research Associates of Princeton, Inc., N.J.
KINETIC EQUATIONS IN THE PRESENCE OF EXTERNAL FIELDS
Guido Sandri Feb. 1963 64 p 9 refs
(Contract AF 49(638)-1140)
(ARAP-48)

In order to control a plasma, it is necessary to use fields which are produced by means external to the plasma itself, and which must, in general, be strong since they generate and harness large inertial forces. Such fields affect a plasma in two major respects: they introduce large spatial (and temporal) inhomogeneities, and they distort the collisional mechanism of the constituents. The kinetic equations are obtained for such gases (plasmas in particular) taking into account both these effects. Author

N63-17247 Japan. Ministry of Transportation. Transportation Technical Research Inst., Tokyo
MULTIREGION REACTOR KINETICS EQUATIONS BASED ON REGION FLUXES
Isao Iyori Mar. 1963 24 p 12 refs
(TTRI-58)

Multiregion reactor kinetics is studied from a viewpoint that the critical flux could be decomposed into a set of fluxes, each of which corresponds to one region of the reactor. (These fluxes are called the "region fluxes.") The principal objective is to find the region fluxes which result in the most correct kinetics equations for the multiregion reactor perturbed over a specified region. One of the leading advantages of this method is that even for the perturbation which excites several higher-mode fluxes, this method gives a good approximation without increasing the dimension of the kinetics equations. Another advantage is the elimination of the eigenvalue problems for the higher-mode fluxes of the unperturbed reactor. Author

N63-17256 Weapons Research Establishment (Australia)
THE ANALYSIS OF ELLIPTICALLY POLARIZED ELECTROMAGNETIC FIELDS USING A DIGITAL COMPUTER Technical Note

J. R. Pyle Mar. 1963 23 p refs
(EID-64)

The analysis of elliptically polarized electromagnetic fields has been carried out using a digital computer (IBM 7090). Circular polarizer characteristics were evaluated for a complete range of experimental values likely to arise in practice. Author

N63-17261 Los Alamos Scientific Lab., N. Mex.
A GENERAL MONTE CARLO NEUTRONICS CODE
Robert R. Johnston May 13, 1963 187 p
(Contract W-7405-eng-36)
(LAMS-2856) OTS: $2.75

A general geometry Monte Carlo code suitable for neutron penetration problems is described. A detailed description of the preparation of a problem and a complete listing of the code are included. Author

N63-17278 Sperry Utah Co., Salt Lake City
ON THE APPLICATION OF LINEAR PROGRAMMING TECHNIQUES TO HUMAN FACTORS IN SPACE PROGRAMS
Paul A. Young *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962 [1962] p 141-145 4 refs (See N63-17266 15-1) OTS: $23.50 ph, $14.33 mf

This paper presents a mathematical model which provides optional crew-task scheduling. The model employs linear programing techniques to define an objective function to be optimized, based upon individual task proficiencies. A discussion of the definition and evaluation of proficiency indices precedes the presentation of the assignment model. Author

N63-17283 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RELIABILITY ANALYSIS OF REDUNDANCY MECHANISMS
Gilbert Friedenreich (Fairchild Stratos Corp.) and Nathan Lichter *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962 [1962] p 227-241 4 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Reliability expressions are derived for two basic functional redundancy techniques as applied to a two-channel system active redundancy (both channels operate) and standby redundancy (one channel operates; the other is switched in upon failure of the first). Each expression is investigated for the effect of the following: (1) Failures of a channel which cause the redundant channel to fail, (2) failures of a channel which do not effect the redundant channel, (3) load sharing, (4) reliability of the switching device. The equations for each of these methods and their specific parameters are contained in their respective sections. Solutions to these equations have been determined over a wide range of variables using the IBM-7090 computer, and the results are shown graphically. Author

N63-17284 Minneapolis-Honeywell Regulator Co. Ordnance Div., Hopkins, Minn.
GRAPHIC SOLUTION OF RELIABILITY LOGIC EQUATIONS
William E. Marshall *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962 [1962] p 243-249 3 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Reliability logic equations can in some instances become extremely complex because of unavoidable duplication, triplication, sequential events, interactions, interdependencies, etc. In these instances, if reliability logic equations are not used, the results of reliability prediction can be deceivingly inaccurate. This paper presents a simple, accurate procedure for graphic solution of reliability logic equations. A 3-phase, solid-state inverter with a failure detecting and switching circuit and a standby-redundant, single-phase inverter is used as an example of how to solve reliability logic equations graphically. Author

N63-17299 Aerojet-General Corp., Azusa, Calif.
RELIABILITY MONITORING BY OPTIONAL STOPPING SAMPLING
Norman R. Garner *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18-21 June 1962 [1962] p 441-446 3 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

An optional stopping sampling procedure is recommended for reliability monitoring. This procedure allows testing to continue until k defects are observed. At this time, one of three decisions are made. If the number of trials is too small, testing is stopped and an engineering charge is required. If the number of trials is too large, then a new reliability plateau has been achieved. If the number of runs is neither too small nor too large, a new sequence of testing begins. Thus, only a minimum amount of testing would be performed on unreliable systems. On the other hand, if an engineering design change were made which improved reliability appreciably, the length of trials would become longer and, so, a more efficient estimate of reliability would be made for the improved system. The mathematical model is discussed, cumulative probabilities are given so that control charts can be established, and an example is presented. Author

N63-17300 General Electric Co. Light Military Electronics Dept., Utica, N.Y.
STATISTICAL CIRCUIT ANALYSIS IN PRACTICE
F. A. Applegated and N.A. Scianna *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS North Island, Calif., 18-21 June 1962 [1962] p 447-462 5 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

This paper describes a program for the collection and use of component-part test data for reliability in general, and for statistical circuit analysis in particular. Author

N63-17342 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON A CONSISTENT SYSTEM OF ASTRODYNAMIC CONSTANTS
Helmut G. L. Krause Dec. 12, 1962 53 p 58 refs
(NASA-TM-X-50106; MTP-P&VE-F-62-12) OTS: $5.60 ph, $1.79 mf

An internally consistent system of astrodynamic constants is derived based upon theoretical coupling relationships and the most recent available experimental data. A new method of determining the ratio of the masses of the earth and moon has been derived, and the results are in agreement with other determinations. An error study of each constant is presented; both relative and absolute probable errors are listed. Author

N63-17344 New York U. Courant Inst. of Mathematical Sciences, N.Y.
SOME IMPLICIT FINITE DIFFERENCE SCHEMES FOR HYPERBOLIC SYSTEMS
John Gary Mar. 1, 1963 21 p 5 refs
(Contract AT(30-1)-1480)
(NYO-10426)

This paper describes two modifications of the Crank–Nicholson scheme for hyperbolic systems which are implicit only in that they require the inversion of tridiagonal matrices. However, these schemes are unconditionally stable only for positive definite systems (supersonic flow). The results of computations using these schemes are described. Author

N63-17363 International Business Machines Corp., Kingston, N.Y.
A FILM ELECTRONICS AIRBORNE COMPUTER
W. N. Carroll *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24–26, 1962 [1963] p 141–160 (See N63-17351 15-09) OTS: $5.00

A study is made of the use of thin-film techniques in airborne computers which are designed to perform the computing function of a weapon-delivery system. This report reviews the circuit design, circuit topological layout, memory design, power requirements, and overall packaging used in this type of airborne computer. J.R.C.

N63-17385 Iowa State U. of Science and Tech., Ames
ROTATION DESIGNS FOR SAMPLING ON REPEATED OCCASIONS Technical Report 2.1
J. N. K. Rao and John E. Graham [1962] 24 p 7 refs
(Grant DA-ARO(D)-31-124-G93)
(AROD-2934-9)

Estimation problems in time-series analysis have received considerable attention for some time, but most of these studies have been devoted to the estimation of parameters in time-series models, usually involving the concepts of infinite populations. Most of the distribution-free theory of sampling finite populations has been concerned with estimates applying to a population at one particular time, and applies to so-called "one shot surveys." This report presents the results of an attempt to combine finite population sampling with time-series analysis and to develop a unified finite population theory. Author

N63-17441 Aberdeen Proving Ground. Ballistic Research Labs., Md.
A SOLUTION OF THE GODDARD PROBLEM
Boris Garfinkel Jan. 1963 26 p 13 refs
(BRL-1194)

The problem of optimizing the thrust of a vertically ascending rocket is solved under the assumption of isothermal atmosphere in two important cases: (1) the jet Mach number is sufficiently large and (2) the drag is a convex function of the velocity. The first case embraces all physical drags and is valid for the earth; the second extends to all atmospheres, but is restricted to drags that are fairly common. With impulsive boosts in velocity admitted, the solution is shown to contain a finite number of such boosts in the sonic region of the rocket velocity, and to contain no coasting arcs except in the terminal stage. Author

N63-17447 Lockheed Missiles and Space Co., Sunnyvale, Calif.
AUTOMATIC PATTERN RECOGNITION DURING THE PERIOD 1961-1962: AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano, comp. May 1963 44 p 140 refs
(SB-63-13)

One hundred and forty references are given on all aspects of automatic pattern recognition for the period 1961–1962. Included are references pertaining to theory and experience with systems, components, methods, optics, speech, etc. The period covered in the search was January 1961–December 1962. Author

N63-17451 Lincoln Lab., Mass. Inst. of Tech., Lexington
A LUNEBURG LENS AS A PASSIVE REFLECTOR FOR SATELLITE COMMUNICATION
R. N. Assaly Aug. 21, 1962 30 p 8 refs
(Tech. Rept. 227)

A specially designed Luneburg lens used as a passive communication satellite in a stationary orbit refracts the energy incident upon it through an angle of 165° to 180°, thus providing a wavefront propagating back in the general direction from which the signal came. Two formulas for the scatter pattern are developed—one approximate, the other accurate. Thus, it is possible to compute values for a minimum lens size that will provide adequate signal return in a radar range. The composition of the lens must take into account the required dielectric constant distribution and yet be sufficiently light in weight. Several such compositions are discussed. Author

N63-17452 RAND Corp., Santa Monica, Calif.
HEAT AND MASS EXCHANGE WITH COOLING OF STRONGLY HEATED SURFACES BY EVAPORATION (TEPLO-I MASSOBMEN PRI OKHLAZHDENNI SIL'NO NAGREVAEMYKH POVERKHNOSTEI IS PARENIEM)
R. Z. Alimov Nov. 1962 20 p 16 refs Transl. from Inzhenerno-Fiz. Zhur. (Minsk), v. III, no. 5, 1960 p 31-39
(Contract AF 49(638)-700; Proj. RAND)
(RM-2997-PR)

In this article, criterial equations of heat and mass transfer are deduced, which take into account the intereffect of the flows of heat and steam across the boundary layer and the effects of Stefan's flow on the values of the coefficients of thermal conductivity and diffusion. The temperature and liquid flow rate, determined by the aid of these equations, are compared with experimental and theoretical data given by other authors. Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-17139 Stanford Research Inst., Menlo Park, Calif.
FREQUENCY DISTRIBUTIONS OF SHOWER SIZES
A. S. Dennis and F. G. Fernald 1963 14 p 5 refs Submitted for Publication
(NASA Contract NASr-49(06))
(NASA CR-50172) OTS: $1.60 ph, $0.80 mf

Classification of radar echoes from isolated showers in terms of radius, r_o, has shown that the number per unit radius interval is proportional to $\exp(-\beta r_o)$, where β is a constant for a given sample. Calculated values of β range from 0.8 to 1.7 (n. mi.)$^{-1}$. Intense convective activity is characterized by small values of β. Weak or shallow showers, such as those forming in trade-wind cumuli, are associated with large values of β. Author

N63-17310 Argonne National Lab., Ill.
THE EFFECTS OF ATMOSPHERIC STABILITY AND HORIZONTAL SHEAR ON THE ACCUMULATION AND DIFFUSION OF RADON
John E. Pearson and Harry Moses *In its* Radiological Physics Div. Semiannual Report, Jan. through June 1962 Feb. 1963 p 151–168 3 refs (See N63-17305 15-01)

Studies of the vertical and temporal distributions of natural atmospheric radon were made in conjunction with accurate measurement of wind and temperature profiles in the area of the Argonne meteorological site. Analysis of the resulting data shows a striking diurnal variation of the radon content in the lower layer of the atmosphere, with the minimum occurring in the afternoon and the maximum shortly before sunrise. During these periods, the kinetic energy of the air column was rather low and the stability was high. In general, the pattern of kinetic energy appears to correlate highly with the radon content, although the relation between the kinetic variables is extremely complex. M.P.G.

N63-17335 Stanford Research Inst. Aerophysics Lab., Menlo Park, Calif.
RAINFALL DETERMINATIONS BY METEOROLOGICAL SATELLITE RADAR Final Report
Arnett S. Dennis Apr. 1963 110 p 83 refs
(NASA Grant NASr-49(06))
(NASA CR-50193)

The difficulties of detecting precipitation from a satellite are outlined, and certain specific systems that have been proposed for overcoming these difficulties are examined. It is concluded that no system proposed to date has any chance of detecting precipitation except at the satellite subpoint. Author

N63-17446 Weather Bureau. Meteorological Satellite Lab., Washington, D.C.
INFRARED FLUX AND SURFACE TEMPERATURE DETERMINATIONS FROM TIROS RADIOMETER MEASUREMENTS
D. Q. Wark, G. Yamamoto, and J. Lienesch Apr. 1963 10 p (MSL-10, Suppl.)

The spectral emissivity of the thermistor detectors of the TIROS radiometers is presented; these data are included in new filter transmission values for TIROS III and IV. Small changes and corrections were introduced into the computer program to produce new intensity values for the 106 model atmospheres. Corrected constants and additional empirical equations for the determination of radiative flux and surface temperature are given. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-17438 Federal Aviation Agency. Systems Research and Development Service, Atlantic City, N.J.
DYNAMIC SIMULATION STUDIES OF PICTORIAL NAVIGATION DISPLAYS AS AIDS TO AIR TRAFFIC CONTROL IN A LOW-DENSITY TERMINAL AREA AND IN AN EN ROUTE AREA Final Report
A. L. Sluka Feb. 1963 73 p

This report describes an ATC dynamic simulation study that was conducted to determine the operational value of cockpit pictorial displays, course line computers, and pictorial computers as aids to air traffic control in a low-density terminal area and in an en route area. The Salt Lake City terminal area was used for the low-density study, while the en route structure from Miami to New York was selected as the en route area of investigation. In the en route studies, particular emphasis was placed on the route structures centered around Miami, Jacksonville, and New York. The study showed that pictorial-display routes, procedures, and techniques can be systematically integrated with the existing system, and generally meshed smoothly with simultaneous use of radar techniques. Improvements were related to a simplification of the control functions, as indicated by reduction in controller workload and an increased ability to manipulate traffic. This modified the control function from that of radar navigation to the less demanding function of radar monitoring. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-16988 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PRELIMINARY EXPERIMENTAL INVESTIGATION OF FREQUENCIES AND FORCES RESULTING FROM LIQUID SLOSHING IN TOROIDAL TANKS
Irving E. Sumner Washington, NASA, June 1963 18 p 8 refs
(NASA TN D-1709) OTS: $0.50

A preliminary experimental investigation was conducted to determine the natural mode frequencies and slosh forces resulting from liquid oscillation in three horizontally oriented toroidal tanks of constant minor radius and varied major radii. The excitation amplitude was held constant, and the excitation frequency was varied to encompass the first and second natural modes of the contained liquids over a range of liquid-depth ratios. Author

N63-16996 Martin Co., Orlando, Fla.
A METHOD FOR PREDICTING THERMAL RESPONSE IN SANDWICH PANELS [Final Report, May 1962-May 1963]
P. J. Kendall, J. P. Moran, and T. E. Chappell Wright-Patterson AFB, Ohio, Flight Dynamics Lab., May 1963 131 p 82 refs
(Contract AF 33(657)-8649)
(ASD-TDR-63-306)

A one-dimensional analysis was developed which employs the ordinary heat balance, considering heat transfer through the panel by conduction, convection, and radiation. The finite (forward) difference technique is employed for solving the heat-balance equations. Honeycomb panels of various materials, cell shapes, and dimensions were subjected to a variety of heat loads and their thermal responses were recorded. The predicted thermal responses for these panels, obtained with the analytical model, were in good agreement with the test data. Author

N63-17023 California U., Berkeley. Lawrence Radiation Lab.
THE ABSOLUTE INTENSITY OF C_2 SWAN BANDS
Lucy Gay Hogan (Ph.D. Thesis) Mar. 18, 1963 121 p 102 refs
(Contract W-7405-eng-48)
(UCRL-10620) OTS: $2.50

The Swan-band system of the C_2 molecule was produced in emission in a source of thermal equilibrium. The ratio was measured of the intensity in emission and in absorption of certain features of the O-O Swan band relative to a black body or to a tungsten lamp by using photographic plates and photoelectric scanning techniques. The absolute intensity for the

feature was obtained therefore, since the absolute intensity of a black body or of a tungsten lamp can be obtained from the Planck equation and the experimentally measured emissivity of tungsten. Experimental results are expressed in terms of the absolute f value or oscillator strength. The absolute f value for the O-O Swan band of C_2 in emission is 0.004 ±0.0007 for the photoelectric scanning experiments on rotational lines, and 0.006 ±0.004 for emission measurements of rotational lines on photographic plates. For emission experiments at the O-O head, the f value is 0.007 ±0.004. Absorption experiments at the O-O band head give an f value of 0.005 ±0.003. The best value for the absolute oscillator strength or f value of the O-O band of C_2, obtained by averaging the f values from the emission and absorption data, is 0.005 ±0.003. Author

N63-17073 Instrument Corp. of Florida, Melbourne
LOCATION AND DETERMINATION OF THE LOCATION OF THE ENTRANCE PUPIL (CENTER OF PROJECTION) OF PC-1000 CAMERA IN OBJECT SPACE Scientific Report No. 1
Duane C. Brown and Ronald G. Davis 1962 11 p 2 refs
(Contract AF 19(628)-346)
(AFCRL-63-481)

A technical discussion on the location of the entrance pupil (center of projection) of a metric lens is presented, and certain misconceptions concerning the relationships between nodal points, the entrance pupil, and the center of projection are revealed. Following this, practical techniques for determining the location of the entrance pupil of a lens and the object space coordinates of this point in the field are presented. Author

N63-17107 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REVIEW OF DIRECT MEASUREMENTS OF INTERPLANETARY DUST FROM SATELLITES AND PROBES
W. M. Alexander, C. W. Mc Cracken, L. Secretan, and O. E. Berg *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 39-60 49 refs (See N63-17105 15-29) OTS: $3.50

More than 10,000 dust-particle impacts have been measured by acoustical and light flash detectors. A cumulative mass-distribution curve valid for average conditions in the vicinity of the earth has been derived from the direct measurements for dust particles with masses between about 10^{-13} and 10^{-6} gm. The results of direct measurements from various penetration and fracture experiments are presented here. Comparison of these data with the average mass distribution curve shows no major discrepancies among the measurements from all of the different sensor systems used. Author

N63-17111 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MIDDLE ULTRAVIOLET PHOTOELECTRIC DETECTION TECHNIQUES
Lawrence Dunkelman, John P. Hennes, and Walter B. Fowler *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 125-137 15 refs (See N63-17105 15-29) OTS: $3.50

In this paper, nondispersive optical techniques are described for the middle (3000 to 2000A) ultraviolet. Bandpass (200 to 300A) and cutoff filters which may be used with conventional cesium-antimony photodetectors are described. When near ultraviolet and longer wavelength radiation must be rejected to a greater degree, "solar blind" photocathodes, with higher work functions, such as the alkali tellurides, can be used. These photodetectors, their calibration, and their applications are discussed. Author

N63-17136 National Bureau of Standards, Boulder, Colo.
THE DENSITIES OF SATURATED LIQUID HYDROGEN
R. D. Goodwin, D. E. Diller, H. M. Roder, and L. A. Weber 1961 Repr. from Cryogenics, Dec. 1961 p 81-83 15 refs
(NASA Order R-45)
(R-226)

New data for the density of saturated liquid *para*-hydrogen from boiling point to critical point is reported. Two approximate methods for representing the data are mentioned briefly while two more-accurate methods are discussed in greater detail. N.E.A.

N63-17151 Virginia U., Charlottesville
FRICTIONAL DRAG ON MAGNETICALLY SUSPENDED ROTORS Final Report
Jesse W. Beams Apr. 30, 1963 5 p
(Grant DA-ARO(D)-31-124-G294)
(AROD-3764-1)

When properly isolated, a magnetically supported rotor coasting freely in air at 10^{-9} torr loses about 10^{-9} of its speed N per second. The often-suggested possibility of spinning both the magnetic support and the chamber enclosing the rotor (outer rotor) at the same speed as the (inner rotor) to further reduce deceleration is discussed. The inner rotor is freely suspended magnetically from the freely magnetically suspended outer rotor. The vacuum chamber surrounds the concentric rotors. The speed of the outer rotor may be monitored by the inner rotor. For short times, $\Delta N/N$ might approach 10^{-15} sec^{-1}. For longer periods, $\Delta N/N$ should depend upon how accurately the effects of creep, temperature, etc., can be eliminated or compensated. Masses attached to the axis by 0-length LaCosta springs are effective governors when $4\pi^2 N^2 Mr = Kr$. The required double magnetic supports are described. Author

N63-17186 California U., Berkeley. Lawrence Radiation Lab.
THE REACTION $\pi^- p \rightarrow \pi^-\pi^+ n$ BELOW 800 MeV
Janos Kirz (Ph.D. Thesis) Mar. 12, 1963 82 p 36 refs
(Contract W-7405-eng-48)
(UCRL-10720) OTS: $2.00

The reaction $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ is studied in the Lawrence Radiation Laboratory 72-inch hydrogen bubble chamber. Events are located by scanning the pictures for π^+ tracks. Cross sections, Dalitz plots, angular distributions, and $\pi^+\pi^-$ and $\pi^\pm n$ mass spectra are given at beam energies of 360, 430, 460, 480, 555, 605, 673, and 780 Mev. No clear evidence is found for $\pi^+\pi^-$ resonances between threshold and $M_{\pi\pi} = 680$ Mev. However, there is a strong preference for high $\pi^+\pi^-$ effective masses, especially at the lowest beam energies. Arguments are given to ascribe this anomaly to the I = 0 state of the $\pi-\pi$ system. Production of the $N^*_{3/2}(1238)$ isobar is observed in its negative charge state. Author

N63-17191 Naval Research Lab., Washington, D.C.
STUDIES OF THE INITIATION OF ELECTRICAL BREAKDOWN IN VACUUM
R. P. Little and W. T. Whitney May 20, 1963 10 p 6 refs
(NRL-5944) OTS: $0.50

It is generally known that an applied field of 10^5 v/cm will produce electron emission from apparently smooth surfaces at room temperature. This prebreakdown current is believed to initiate electrical breakdown in vacuum. Experimentally, it has been found that this prebreakdown emission is independent of

emitter temperature up to 800° C. By using electron-shadow-microscope techniques, projections about two microns high, capable of producing field enhancements of the order of 100, have been found on optically polished cathodes at prebreakdown emission sites. This, with other evidence, strongly indicates that prebreakdown emission is Fowler–Nordheim field emission, due to geometrical field enhancement. Author

N63-17196 Knolls Atomic Power Lab., Schenectady, N.Y.
REACTOR TECHNOLOGY REPORT — PHYSICS
K. A. Kesselring May 1963 120 p 55 refs
(Contract W-31-109-eng-52)
(Rept. 23; KAPL-2000-20) OTS: $2.50

Reactor physics research is reported on the following: determining the important reactor phenomena from macroscopic descriptions of the group constants and comparison with data such as the criticality and flux distribution; cross sections of nuclear data from fundamental research using pile oscillator techniques and studies of nuclear theory; neutron spectra and fluxes, the detailed behavior of neutron distributions; a variational procedure to determine the effects of nonlinear phenomena in reactor kinetic problems; and compiling a glossary of nuclear physics computer programs. D.E.R.

N63-17212 Stanford Research Inst., Menlo Park, Calif.
ON THE QUANTUM VIRIAL EXPANSION
Felix T. Smith 1963 6 p 6 refs Submitted for Publication
(NASA Contract NASr-49(07))
(NASA CR-50132)

The quantum mechanical form of the virial expansion for the equation of state of fluids is studied and the equivalence of two forms of the quantal cluster expansion is demonstrated. It is found that, by a wave-packet analysis, the lifetime expansion provides a convenient bridge between the quantal and classical cluster theories. D.E.R.

N63-17225 Yale U., New Haven, Conn.
EXPERIMENTAL LIMITS FOR THE ELECTRON-PROTON CHARGE DIFFERENCE AND FOR THE CHARGE OF THE NEUTRON
Jens C. Zorn (Ph.D. Thesis), George E. Chamberlain and Vernon W. Hughes Repr. from Phys. Rev., v. 129, no. 6, Mar. 15, 1963 p 2566–2576 refs
(NASA Grant NsG-1-59)
(NASA-CR-50041)

Upper limits for the electric charges on the atoms of cesium and potassium and the molecules of hydrogen and deuterium have been measured by a molecular-beam-deflection method. The results are: $q(Cs) = (1.3 \pm 5.6) \times 10^{-17}\ q_e$, $q(K) = (-3.8 \pm 11.8) \times 10^{-17}\ q_e$, $|q(H_2)| < 2 \times 10^{-15}\ q_e$, and $|q(D_2)| < 2.8 \times 10^{-15}\ q_e$ (q_e is the absolute value of the electron charge). They are consistent with the usual view that atoms and molecules are electrically neutral. The results on H_2 and D_2 provide very direct upper limits of $1 \times 10^{-15}\ q_e$ for the electron-proton charge difference and $2.4 \times 10^{-15}\ q_e$ for the neutron charge. The cesium result can be interpreted as showing that the magnitude of the electron charge differs from that of the proton by less than 5 parts in 10^{19} and that the neutron charge is less than $5 \times 10^{-19}\ q_e$. The relevance of charge equality to cosmological theory, and to the theory of elementary particles, is discussed. Author

N63-17230 Sylvania Electric Products, Inc. Applied Research Lab., Waltham, Mass.
COMPARISON BETWEEN SPECTRAL SCANNING THEORY AND CLASSICAL COLOR VISION THEORIES
George Biernson May 16, 1963 17 p 6 refs
(NASA Contract NASw-441)
(NASA CR-50350: Res. Note-396) OTS: $1.60 ph, $0.80 mf

A detailed comparison of experimental evidence relative to the Spectral Scanning theory and the Trichromatic theory, shows that the Spectral Scanning theory is at least as consistent with this evidence as is the Trichromatic theory. A preliminary examination of the energy distributions produced by the waveguide mode effect is made, and shows what appears to be the basis for agreement between waveguide mode patterns and color mixture data. As a supplement, a detailed discussion of visual adaptation relative to the Spectral Scanning theory is given. N.E.A.

N63-17240 California U., Berkeley. Lawrence Radiation Lab.
$\pi^+ - p$ SCATTERING AT 600 MeV
Peter C. A. Newcomb Jan. 7, 1963 81 p 22 refs
(Contract W-7405-eng-48)
(UCRL-10563)

The Berkeley 15-inch hydrogen bubble chamber was used at the Bevatron to investigate $\pi^+ - p$ interactions at 600 Mev. Seventeen hundred and thirty-eight good events were found; 71.9 ±0.8% of these were elastic. The inelastic interactions were almost entirely single pion production. For the single pion production, the ratio of the number of interactions of the type $\pi^+ + p \rightarrow \pi^+ + p + \pi^0$ to those of the type $\pi^+ + p \rightarrow \pi^+ + n + \pi^+$ was found to be 5.5 ±0.8. This result is in good qualitative agreement with the value 6.5 predicted by Sternheimer and Lindenbaum. The pion momentum spectra for the reaction $\pi^+ + p \rightarrow \pi^+ + p + \pi^0$ do not show the dip predicted by Bergia, Bonsignori, and Stanghellini. A peak was found in the $Q(\pi^+\pi^0)$ distribution; however, it is thought that this peak is more likely to be an effect of the (3/2, 3/2) pion–nucleon isobar than that of a π–π resonance. Angular distributions are also given for the inelastic events. Author

N63-17249 Oak Ridge National Lab., Tenn.
PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1963
June 7, 1963 166 p refs
(Contract W-7405-eng-26)
(ORNL-3425) OTS: $2.75

This report contains the abstracts of papers which have been published or prepared for publication by the physics division of the Oak Ridge National Laboratory. D.E.R.

N63-17257 General Dynamics Corp. General Atomic Div., San Diego, Calif.
INTEGRAL NEUTRON THERMALIZATION Annual Summary Report, Oct. 1, 1961 through Sept. 30, 1962
J. R. Beyster et al Washington, AEC Div. of Tech. Information, Mar. 15, 1963 210 p 58 refs
(Contract AT(04-3)-167)
(GA-3542) OTS: $3.00

New techniques and improvements made in procedures for studying neutron thermalization are discussed. Facility improvements and major equipment performance are also reported. The work performed on thermalization is summarized, including the topics: spatially dependent, finite medium spectra in multiplying and nonmultiplying systems; infinite medium studies; the scattering law; some nonstationary problems; a description of the codes used in spectral analysis; the spatial dependence of thermal neutron spectra; and the spectra produced by low-energy sources. D.E.R.

N63-17307 Argonne National Lab., Ill.
A MEASUREMENT OF THE PHOTOLUMINESCENT QUANTUM YIELD OF LIQUID SCINTILLATORS. Preliminary Report
W. R. Anderson and I. B. Berlam *In its* Radiological Physics Div. Semiannual Report, Jan. through June 1962 Feb. 1963 p 34–41 11 refs (See N63-17305 15-01)

Two methods for determining the photoluminescent quantum efficiency of various liquid scintillators are investigated. Ideally, if the fluorescent emission were distributed uniformly in all directions and the exciting ultraviolet light could also be scattered uniformly by some medium, the ratio between the total number of photons emitted and the number absorbed could be determined from the ratio of the amounts detected in a particular direction. However, the emission from scatterers is, in general, nonuniform although the emission from fluorescent solutions is approximately uniform, so that the two measurements cannot be compared directly. The first indirect method investigated involves the use of an "integrating sphere" in which the scatterer and the fluorescent sample are illuminated in succession at the center of a sphere having a highly diffusing interior surface. The sphere homogenizes the light through multiple reflection so that the luminosity of the interior surface is a measure of the total flux. The second method involves an analysis of the degree of polarization of the radiation of both the scatterer and the fluorescent solution in the direction of a detector. The degrees of polarization, the ratio of measured intensities, and the ratio of total fluxes bear a known relationship to each other. Further studies are being made to improve the reliability of both methods. M.P.G.

N63-17308 Argonne National Lab., Ill.
NEUTRON PRODUCTION IN MASSIVE SHIELDS AND EFFECT UPON THE LOW-ENERGY GAMMA-RAY BACKGROUND
H. A. May *In its* Radiological Physics Div. Semiannual Report, Jan. through June 1962 Feb. 1963 p 50–65 21 refs (See N63-17305 15-01)

The physics of the penetrating (muon) and nucleonic (high-energy neutron, and proton) components of cosmic radiation are reviewed to elucidate the low-energy gamma ray background observed by crystal detectors inside massive shields. The results of a series of experiments involving various combinations of shielding materials, materials thickness, and building construction materials overlying the massive shield materials, as well as surrounding the crystal detector with plain or borated paraffin, are discussed. The possibilities of efficiently reducing the major portion of the cosmic ray contribution to background gamma radiation by minimizing the production of evaporation neutrons in the shielding material (by choosing a shielding material with low atomic mass) are also discussed. M.P.G.

N63-17309 Argonne National Lab., Ill.
EFFECT OF SILVER HALIDE CONTENT ON THE FILM DOSIMETRY OF A $Sr^{90} - Y^{90}$ APPLICATOR
Amrik S. Chhabra *In its* Radiological Physics Div. Semiannual Report, Jan. through June 1962 Feb. 1963 p 68–77 7 refs (See N63-17305 15-01)

Different dilutions of G5 Ilford emulsion have been used in Lucite for depth-dose measurement of radiations emitted by a Sr^{90} - Y^{90} β-ray applicator, and compared to results obtained with a Failla extrapolation chamber. The response of emulsion with normal silver content is quite satisfactory in the β-ray region, but it is too sensitive in the bremsstrahlung region by a factor of $\simeq 40$. The response of emulsions, in which the AgBr: gelatin ratio is decreased by as much as a factor of five, approaches somewhat that of the ionization chamber, in fair agreement with calculations based on Greening's formulation; but it is still too high for accurate dose measurements in regions where the contribution from bremsstrahlung is of the order of a few percent. Values of 2250 and 460 ev were found for the energy required to produce a developable grain. Author

N63-17315 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY X: ATOMIC POLARIZABILITIES AND SHIELDING FACTORS
A. Dalgarno Feb. 1963 87 p 96 refs Submitted for Publication (NASA Contract NASw-395)
(NASA CR-6; GCA-TR-63-2-N) OTS: $8.10 ph, $2.81 mf

The changes in the charge distribution of an atom interacting with an electric field and the various shielding effects of the inner closed shells of electrons on the distribution of nuclear and electron charge are discussed. The definitions and quantal formulae are explained, the approximations for the perturbation theory are presented, and solutions via variational methods, the Hartree–Fock approximation, expansion methods, and statistical methods are given. Finally, numerical values for dipole and quadrupole polarizabilities and for the quadrupole and higher order shielding factors are presented in tabular form. D.E.R.

N63-17321 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
UNDERGROUND EFFECTS OF NUCLEAR WEAPONS IN THE CLOSE-IN REGION – VOLUME IV Final Report
G. F. McDonough, Jr. Mar. 14, 1963 174 p 13 refs
(Contract DA-49-146-XZ-073)
(DASA-1357(IV))

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APPENDIX I: UNIFORM EXPONENTIAL PRESSURE PULSE N. M. Newmark p I1-I-13 (See N63-17327 15-23)

N63-17322 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
THE HUGONIOT EQUATION OF STATE – APPENDIX A
T. Trippe and G. F. McDonough, Jr. *In its* Underground Effects of Nuclear Weapons in the Close-in Region–Vol. 4 Final Rept. Mar. 14, 1963 p A-1–A-4 1 ref (See N63-17321 15-23)

The Hugoniot equation of state is derived which relates pressure and volume immediately behind a shock front to pressure and volume of the front. Given the equation of state for the material in which the shock is propagated and the pressure and volume ahead of the shock, the Hugoniot is a uniquely determined curve in the pressure-volume plane. The equations derived define the specific internal energy, specific volume and pressure behind the shock in terms of the conditions ahead of the shock, and the shock-front velocity and particle velocity

behind the front. Therefore, the conditions behind the front can be determined from measurement of the shock-front velocity and particle velocity. J.R.C.

N63-17323 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
STATISTICAL DETERMINATION OF THE EQUATION OF STATE AT HIGH PRESSURES – APPENDIX B
G. F. Mc Donough, Jr., and T. Trippe *In its* Underground Effects of Nuclear Weapons in the Close-in Region–Vol. 4 Final Rept. Mar. 14, 1963 p B-1–B-6 3 refs (See N63-17321 15-23)

Statistical determination of the equation of state of rocks at pressures above 1,000 kilobars is made. At extremely high temperatures and pressures, pressures above 10^7 kilobars for usual earth materials, complete ionization occurs and the resulting mixture of electrons and nuclei can be considered to be an ideal gas in determining the equation of state. In the range of from 10^3 to 10^7 kilobars, it is necessary to use some approximation of the nonideal behavior of the rock. If the number of atoms of each type in a given quantity of the material is known, then the total volume and total internal energy of the mixture for a specified temperature and pressure can be determined. Thus, in this way the equation of state of any material at high temperatures and pressures can be determined. J.R.C.

N63-17324 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
S R I FORMULATION AND RESULTS – APPENDIX D
G. F. Mc Donough, Jr. *In its* Underground Effects of Nuclear Weapons in the Close-in Region–Vol. 4 Final Rept. Mar. 14, 1963 p D-1–D-28 1 ref (See N63-17321 15-23)

Solutions are given for elastic half-spaces based on the method of characteristics for evaluating the solution of hyperbolic differential equations. For the half-space problem it was necessary to extend the method from two to three variables. The key to the solution is the reduction of the problem from second- to first-order partial differential equations, which are then replaced by difference equations and evaluated numerically. This provides a less complex method than the inversion of integral transforms of the equations of motion written in terms of scalar and vector potential. C.L.W.

N63-17325 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
GILBERT RAYLEIGH-WAVE SOLUTION – APPENDIX E
Freeman Gilbert and G. F. Mc Donough, Jr. *In its* Underground Effects of Nuclear Weapons in the Close-In Region–Vol. 4 Final Rept. Mar. 14, 1963 p E-1–E-34 4 refs (See N63-17321 15-23)

The Gilbert solution of the transient response of the elastic solid half-space when subjected to surface pressures produced by a point source in a fluid half-space above the solid are summarized. The results of computations of total response of the elastic half-space are examined and the Rayleigh wave effects identified by the retrograde, particle-motion characteristic of the Rayleigh wave. Stresses arising from the Rayleigh wave are less important than other air-induced effects in the close-in region and can be neglected for most design applications without introducing appreciable error into the analysis. Results of experimental investigations are presented to demonstrate the agreement of the analysis with empirical data. J.R.C.

N63-17326 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
EQUATIONS FOR AXIALLY SYMMETRIC WAVE PROPAGATION IN SOIL – APPENDIX H
John A. Brooks *In its* Underground Effects of Nuclear Weapons in the Close-In Region–Vol. 4 Final Rept. Mar. 14, 1963 p H-1–H-34 4 refs (See N63-17321 15-23)

The equations for axially symmetric plastic wave propagation in soil due to a surface nuclear explosion are derived. The mathematical analysis is limited to treatment of the plastic zone and to disturbances caused by directly transmitted shock. The air-induced pulse is ignored and simultaneous treatment of the hydrodynamic and plastic zones is not attempted. The equations to be solved consist of the equations of motion and the yield equations which serve to partition strains and displacements into elastic and plastic components. Accelerations are linear functions of time derivatives, and stresses are linear functions of elastic strains. Nonlinearities enter the problem only through partitioning of strains into elastic and plastic components. The yield equations are derived from Coulomb's yield condition. J.R.C.

N63-17327 Plesset (E.H.) Associates, Inc. Engineering Div., Santa Monica, Calif.
UNIFORM EXPONENTIAL PRESSURE PULSE – APPENDIX I
N. M. Newmark *In its* Underground Effects of Nuclear Weapons in the Close-In Region–Vol. 4 Final Rept. Mar. 14, 1963 p I-1–I-13 (See N63-17321 15-23)

The uniform exponential pressure pulse is determined for a spherical cavity of radius, a, in an infinite, homogeneous, isotropic, elastic half-space. The cavity surface is loaded by a radial normal stress $\sigma_{rr}(\phi, \theta, t)$ where ϕ and θ are angles locating a point on the surface of the sphere. For this case, the only nonzero displacement is the radial displacement, u, and the only nonzero stresses are σ_{rr} and the tangential normal stresses $\sigma_{\theta\theta}$ and $\sigma_{\phi\phi}$. For small displacements, the equation of motion in the radial direction becomes

$$\frac{\partial \sigma_{rr}}{\partial r} + \frac{2\sigma_{rr} - \sigma_{\theta\theta} - \sigma_{\phi\phi}}{r} = P\ddot{u},$$

where P is the mass density, u is the radial acceleration, r is the radial distance, and the stresses are as defined. J.R.C.

N63-17334 Oklahoma U. Research Inst., Norman
A DIRECT METHOD FOR MEASURING LIFETIMES OF EXCITED ATOMIC STATES AND ITS APPLICATION TO HELIUM
Thomas Milton Holzberlein (Ph.D. Thesis) May 1963 124 p 19 refs
(Contract AF 49(638)-0639; Grant AF-AFOSR-62-378)

A direct method for measuring the lifetimes of excited atomic states by analysis of photographs of a dual beam oscilloscope display of a photomultiplier tube output signal is described. This method was applied to six different spectral lines of helium at four different pressures, and the results indicate (1) the validity of the method, and (2) that the steady-state conditions show up as distinct from short-pulse conditions; this indicates that cascading population of states may be a much more important effect than direct excitation for certain states and at certain electron energies. M.P.G.

N63-17338 Rice U., Houston, Tex.
INTERNAL FRICTION PEAKS IN SILVER AND PLATINUM AT LOW TEMPERATURES
S. Okuda Repr. from Appl. Phys. Letters, v. 9, no. 9, May 1, 1963 p 163–164
(NASA Grant NsG-6-59)
(NASA CR-50211)

In connection with a study of the low-temperature annealing on low-temperature internal friction peaks, the location of the Bordoni internal friction peaks in polycrystalline silver

(99.99%) and platinum (99.99%) wires, prestrained in torsion, was determined at a measuring frequency of about 1 cps. These results, along with those of Bordini and others, determined at high frequency, allow the determination of the activation energy and attempt frequency associated with the Bordoni peak in these materials over a frequency range covering about 6 orders of magnitude. N.E.A.

N63-17377 Hughes Aircraft Co., Fullerton, Calif.
EFFECTS OF NUCLEAR RADIATION ON ELECTRONIC EQUIPMENT
T. D. Hanscome *In* Office of Naval Research, Wash., D.C. Proc. of 2nd Conf. on Navy Microelectronics Program, Wash., D.C., Sept. 24-26, 1962 [1963] p 347-354 (See N63-17351 15-09)
OTS: $5.00

The data used in this paper are derived from two previous papers given at the SAE Convention in 1961 and at the WESCON Conference in 1960, and updated for presentation at the Microelectronics Conference. Author

N63-17396 Aerospace Information Div., Library of Congress, Washington, D.C.
ASYNCHRONOUS ACTIONS. ANNOTATED BIBLIOGRAPHY, JANUARY 1958– DECEMBER 1962
June 14, 1963 12 p 28 refs
(AID-B-63-84) OTS: $1.60 ph, $0.80 mf

This annotated bibliography presents discussions and analyses of the synchronization of self oscillations, asynchronous oscillations, and oscillation behavior in self oscillating systems. C.L.W.

N63-17397 Aerospace Information Div., Library of Congress, Washington, D.C.
STIMULATED EMISSION FROM ORGANIC MOLECULES WITH POSSIBLE LASER APPLICATIONS Review Article
June 17, 1963 7 p
(AID-P-63-85) OTS: $1.10 ph, $0.80 mf

A general outline is presented of U.S.S.R. papers on organic materials for Soviet lasers and the type of work being done in the U.S.S.R. in the laser field. N.E.A.

N63-17445 Babcock and Wilcox Co. Nuclear Development Center, Lynchburg, Va.
THERMAL ACTIVATION METHOD FOR ρ_{28} MEASUREMENTS IN SLIGHTLY ENRICHED URANIUM OXIDE LATTICES
R. H. Lewis, T. C. Engelder, D. M. Roberts, and D. B. Wehmeyer
May 1963 53 p 11 refs
(Contract AT(30-1)-2602)
(BAW-2168; CA-7) OTS: $1.25

This report describes the thermal activation method for measuring ρ_{28} in heterogeneous slightly enriched UO_2 lattices, and gives results for 12 water-moderated lattices. The technique has three primary advantages over conventional U^{238} cadmium-ratio measurements: (1) uranium activities are measured by chemically processing the irradiated fuel to avoid problems associated with the use of U^{238} foils, (2) cadmium-covered uranium measurements are eliminated to avoid cadmium perturbations, and (3) ρ_{28} is obtained directly, rather than by subtracting one from the cadmium ratio, to avoid large errors when the cadmium ratio approaches unity. The technique compares total absorptions in U^{238} to thermal absorptions. Then the thermal absorptions in dysprosium and uranium are normalized in a thermal irradiation. The technique is shown to be capable of measuring ρ_{28} with an accuracy of 1%, independent of the value of ρ_{28} and relatively free from systematic errors. Author

N63-17471 Yale U. Observatory, New Haven, Conn.
DEPARTURES FROM LTE IN EMISSION AND ABSORPTION BY CONTINUOUS ENERGY STATES. I. RADIATIVE EQUILIBRIUM [Interim Technical Report]
Ludwig Oster Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Mar. 1963 23 p 6 refs
(Contract AF 33(657)-7271)
(ARL-63-63)

A general formulation of the theory of departures from LTE in free-free emissions and absorption is developed. The problem is treated subject to the restrictions to steady-state and radiative interactions. Particle distribution function and radiation field are studied separately; special attention is given to the transfer problem. The possibility of negative absorption (maser action) is discussed. Author

N63-17477 Atomics International, Canoga Park, Calif.
CRITICAL EXPERIMENTS ON SLIGHTLY ENRICHED URANIUM METAL FUEL ELEMENTS IN GRAPHITE LATTICES
R. W. Campbell, R. J. Doyas, H. C. Field, C. A. Guderjahn, R. L. Guenther, D. F. Hausknecht, M. S. Mayer, and H. A. Morewitz June 30, 1963 38 p 8 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7541) OTS: $0.75

A series of clean critical experiments was performed in the SGR critical facility utilizing 2 wt percent enriched, uranium metal, hollow cylinder, fuel element in AGOT graphite moderator. Six lattice spacings were used, varying from 6.93 to 16.0 in. on a triangular pitch. Critical loadings and fuel element worths were determined and compared to the results of 4-group diffusion theory. Calculations utilized TEMPEST, S_4 FORM, and AIM-5 programs on the IBM 7090. The calculated k_{eff} compares well with experiments over the full range of moderator-to-fuel volume ratios when using a 2200 m/sec graphite absorption cross section of 4.07 mb. The sensitivity of the calculation to variations in the graphite absorption cross section was examined, and the experimental error due to inventory uncertainties was assessed. The differential worths of both the central and peripheral fuel elements were obtained, and they agreed in general with AIM-5 calculations. The thermal flux traverse of a unit cell was shown to agree best with a Wilkins' spectrum option of TEMPEST. Details of both the experimental and theoretical methods are given. Author

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-17055 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
LONG LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT Interim Scientific Report No. 2, June 15-Sept. 15, 1962
Sept. 11, 1962 94 p 5 refs
(Contract AF 33(657)-8311)
(AD-284753)

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3. COMPARISON OF CALCULATED ELECTRON MOBILITY AND ELECTRICAL CONDUCTIVITY OF CESIUM SEEDED HELIUM WITH THAT MEASURED IN AN MHD DUCT T. C. Tsu, L. S. Frost, and R. L. Hundstad 6 p 1 ref (See N63-17058 15-24)
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N63-17056 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

OPERATING CHARACTERISTICS OF MHD LOOP

S. Way July 3, 1962 *In its* Long Life Closed Loop MHD Research and Development Unit, Interim Sci. Rept. No. 2, June 15-Sept. 15, 1962 Sept. 11, 1962 21 p 4 refs (See N63-17055 15-24)

(Research Memo 62-918-266-M2)

For assumed cross sections of 2 3/16" × 3 1/8" in the motor and 2 3/16" × 2 3/4" in the generator, motor-inlet stagnation temperature 2150° K and mean generator temperature 2160° K, and with He + .015 Cs gas, B-field of 1.7 webers/m^2, and generator efficiency 0.6, the loop performance parameters are calculated for various excess pressures (excess of pressure rises over estimated pressure drops) at two values of applied voltage. Author

N63-17057 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

EFFECT OF SIZE ON PERFORMANCE OF MHD MACHINES

T. C. Tsu Aug. 7, 1962 *In its* Long Life Closed Loop MHD Research and Development Unit, Interim Sci., Rept. No. 2, June 15-Sept. 15, 1962 Sept. 11, 1962 3 p (See N63-17055 15-24)

(Research Memo 62-118-266-M5)

In an MHD machine the useful work is done by a body force. In a turbomachine or piston machine, the useful work is done by a surface force. Since most of the losses are area dependent, the efficiency of an MHD machine improves with size much faster than a turbomachine or piston machine.

Author

N63-17058 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

COMPARISON OF CALCULATED ELECTRON MOBILITY AND ELECTRICAL CONDUCTIVITY OF CESIUM SEEDED HELIUM WITH THAT MEASURED IN AN MHD DUCT

T. C. Tsu, L. S. Frost, and R. L. Hundstad Sept. 6, 1962 *In its* Long Life Closed Loop MHD Research and Development Unit, Interim Sci. Rept. No. 2, June 15-Sept. 15, 1962 Sept. 11, 1962 6 p 1 ref (See N63-17055 15-24)

(Research Memo 62-118-266-M6)

Under the reported test conditions, the observed electron mobility was 1.51 m^2/(volt)(sec) while the calculated value was 2.28 m^2/(volt)(sec). The difference is believed to be due principally to the presence of impurities in the working fluid. The electron density, deduced from electron mobility and gas conductivity, is consistent with that given by Saha's equation.

Author

N63-17059 Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

CLOSED LOOP MHD EXHAUST HEAT EXCHANGER

J. A. Cyphers Sept. 14, 1962 *In its* Long Life Closed Loop MHD Research and Development Unit, Interim Sci. Rept. No. 2, June 15-Sept. 15, 1962 Sept. 11, 1962 11 p (See N63-17055 15-24)

(Research Memo 62-118-942-M4)

An exhaust-gas cooling system to be used with the Westinghouse Closed Loop MHD Research Unit is described. The system employs concentric tubes together with convection, radiation, and liquid water-cooling processes. Author

N63-17080 Air Force Cambridge Research Labs., Bedford, Mass.

ON THE CHARACTERISTICS OF A GLOW DISCHARGE BETWEEN COAXIAL CYLINDERS IMMERSED IN A MAGNETIC FIELD

Joseph E. Hoffman, Jr. Apr. 1963 89 p 13 refs

(AFCRL-63-121)

The effect of a strong magnetic field on the glow discharge between coaxial brass or aluminum cylinders is investigated. Pressures range from one to two hundred microns, and the magnetic field varies from zero to five hundred gauss. Ignition and sustaining voltages are plotted against field strength and pressure. Tube current versus field strength is plotted with pressure and terminal voltage as parameters. Also, tube current versus terminal voltage is plotted with pressure and field strength as parameters. Comparison with the results of previous investigators and with available theory is made. Author

N63-17101 RAND Corp., Santa Monica, Calif.

ACCELERATION OF CHARGE PARTICLES BY HYDROMAGNETIC SHOCK WAVES

J. W. Kern Mar. 1963 31 p 15 refs

(NASA Contract NASr-21(05))

(NASA CR-50337; RM-3527-NASA) OTS: $3.60 ph, $1.13 mf

Two mechanisms are discussed for the acceleration of particles trapped in the magnetosphere. Both are associated with the propagation of strong hydromagnetic (HM) shock waves through the magnetosphere. One accelerates thermal electrons throughout the magnetosphere. The other affects energetic particles trapped in the magnetosphere, and can lead to changes in their energy and pitch-angle distributions. A single HM shock wave is shown to be capable of producing, by either (or both) mechanisms, significant ring currents. Author

N63-17160 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECT OF A UNIFORM EXTERNAL PRESSURE ON THE BOUNDARY OF THE GEOMAGNETIC FIELD IN A STEADY SOLAR WIND

John R. Spreiter and B. Jeanne Hyett Repr. from J. Geophys. Res., v. 68, no. 6, Mar. 15, 1963 p 1631-1642 13 refs

Approximate solutions are given for the shape of the boundary separating the geomagnetic field from the interplanetary plasma for a model that assumes the plasma pressure to be composed of two components. One is a dynamic pressure proportional to the normal component of the momentum of the particles of a steady and undisturbed uniform incident stream, as is customary in the usual formulation of the steady-state Chapman-Ferraro problem. The other is a static pressure considered constant over the boundary surface. Results are determined for the traces of the boundary in the equatorial plane and in the meridian plane containing the sun-earth line for a complete range of values for the ratio between the two pressure components. Only the case in which the dipole axis is normal to the direction of the incident stream is considered, however. The principal qualitative feature of including the effect of a uniform external pressure is that the geomagnetic field terminates at a finite distance from the earth in the antisolar direction that is only a moderate multiple greater than in the solar direction for all but extremely small ratios of static to dynamic pressure. This result indicates that the asymmetry between the distances to the boundary of the geomagnetic field on the day and night

sides of the earth may be greatly exaggerated by the results of the usual calculations in which the static pressure is disregarded. Author

N63-17224 RAND Corp., Santa Monica, Calif.
AIR CONDUCTIVITY PRODUCED BY NUCLEAR EXPLOSIONS
W. J. Karzas and R. Latter May 1963 18 p 7 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3671-PR)

In the present report, the spectrum of secondary electrons as they slow down is estimated, and the electronic conductivity per electron is shown to be equal to that for a mean electron energy corresponding to thermal and electrical equilibrium. For sea-level nuclear explosions, this mean energy is determined by the equilibrium electric field of about 1 esu and is about 0.16 ev. Author

N63-17333 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
THE ELECTROMAGNETIC FIELDS OF CERTAIN UNIAXIALLY ANISOTROPIC DIELECTRIC SLABS
Frank M. Labianca Apr. 9, 1963 46 p 20 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1151-63)

Two problems are considered, both of which are characterized by essentially the same geometry. In the first problem, the properties of surface waves propagating in a slab of uniaxially anisotropic dielectric are studied. The slab is of finite thickness, and the relative dielectric constants of the dielectric tensor are all positive. Two cases are studied simultaneously, one being the case where the optical axis is chosen parallel to the slab, and the other being the case where the optical axis is chosen perpendicular to the slab. In the second problem, the electromagnetic fields of a uniaxially anisotropic plasma slab in the presence of a magnetic line source are studied. The geometry is the same as for the first problem, except that the optical axis is chosen parallel to the slab and perpendicular to the direction of the line source. The line source is located either outside the slab or at a conducting plane (i.e., an infinite slot) covered by the slab. Under the conditions described, it is found that the structure can support an infinite number of discrete E-mode surface waves for any frequency less than the plasma frequency. The resultant surface wave field can be expressed as a convergent series obtained by evaluating the residue terms which arise in the steepest descent representation. Furthermore, it is found that all the surface waves are forward waves insofar as propagation along the slag is concerned. Author

N63-17339 New York U. Coll. of Engineering, N.Y.
INTERACTION BETWEEN THE SOLAR WIND AND THE GEOMAGNETIC FIELD Project Report
James Hurley Mar. 1, 1961 82 p 6 refs
(NASA Grant NsG-108-61; Contract DA-36-0390-SC-87171; ARPA Order 163-61)
(NASA CR-50239) OTS: $8.10 ph, $2.66 mf

The solar wind is a highly ionized plasma and, as such, may well influence the earth's magnetic field. This interaction has been studied. The plasma wind is considered as impinging upon an arbitrarily oriented two-dimensional magnetic dipole. It is found that the field is compressed by the plasma and essentially confined to form a cavity in the plasma wind. The thickness of the boundary layer within which the plasma and field interact is found to be small. The equation of this boundary surface and the extent to which the field is changed by such a confinement have been determined. Author

N63-17395 Michigan U., Ann Arbor
ENERGY ADDITION TO A FLOWING GAS BY HIGH-REPETITION-RATE, ARRESTED-BREAKDOWN DISCHARGES
H. C. Early and F. J. Martin Wright-Patterson AFB, Ohio, Mar. 1963 57 p 7 refs Submitted for Publication
(Contract AF 33(616)-7243)
(ARL-63-54)

When a steep-front impulse voltage is applied to a pair of corona-type electrodes, a current of several thousand amperes will flow through the gas for a period of 10^{-8} to 10^{-7} second before spark streamer formation takes place. If the voltage is removed quickly enough, and the duration of current flow is short enough, several joules of energy can be delivered to an atmospheric-density gas in a single suppressed-breakdown pulse. By using pulse repetition rates of several thousand per second, several kilowatts of electrical power can be delivered to a subsonic or supersonic gas stream by a single set of electrodes. Compared to arc-heating methods, the pulsed-corona discharge is diffuse and uniform, and the gas flow remains much more homogeneous. In addition to possible wind-tunnel-air-heating applications, the process may be useful for MHD and other research requiring a nonequilibrium gas having substantial ionization and conductivity at room temperature. Author

N63-17398 Princeton U. Plasma Physics Lab., N.J.
SYMMETRIZATION OF THE MODEL C STELLARATOR
Don J. Grove, Wynford L. Harries, Rolf M. Sinclair, and Shoichi Yoshikawa May 1963 9 p 5 refs
(Contract AT(30-1)-1238)
(MATT-192)

The measurements of various plasma parameters are used as functions of the total effect of a uniform transverse magnetic field on the plasma behavior to find the value of the transverse field and to predict the lack of closure of the confining field when it is used to close the flux lines of the plasma field and create symmetry in a stellarator. Then the dependence of the plasma parameters and the value of the transverse field are shown to depend on the confining field coil positioning, and the calculated and observed effects of coil movement are shown to agree. These calculations can be applied to predict quite accurately the result of small coil displacements on the plasma parameters of the model C stellarator, whose confining field is generated by 36 solenoidally-wound coils spaced along the axis of the toroid and equaling the effect of a transverse field. D.E.R.

N63-17474 Illinois U. Electrical Engineering Research Lab., Urbana
MICROWAVE INVESTIGATION OF ELECTRICALLY DRIVEN SHOCK WAVES IN GASES Scientific Report No. 4
J. Gerardo, C. D. Hendricks, Jr., and L. Goldstein Mar. 1963 136 p 52 refs
(Contract AF 19(604)-7473)
(AFCRL-63-123)

The application of microwave interaction with gaseous plasmas to the study of electrically driven shock waves in inert gases and gaseous plasmas is discussed. The microwave techniques used in this work include: (1) phase shift and resonant probe methods of measuring electron densities in the shock wave, (2) Doppler frequency shift of a microwave signal reflected by the hock-wave plasma which enables one to measure the velocity of propagation of shock waves, and (3) radiometer measurements of the noise power radiated by the shock-wave plasma in the microwave frequency range. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-17017 Louisiana State U. and Agricultural and Mechanical Coll., Baton Rouge

ELECTRON TRANSPORT PHENOMENA IN BISMUTH AT LIQUID HELIUM TEMPERATURES – PART I Interim Technical Report No. 4

C. G. Grenier, J. M. Reynolds, and J. R. Sybert Mar. 1963 75 p refs

(Grant DA-ORD-31-124-61-G76)

(AROD-1579-12)

Transport effects were studied in a bismuth single crystal at liquid-helium temperatures in a magnetic field. The thermal conductivity was found to be almost entirely due to lattice conductivity; therefore, the experimental coefficients determined were limited to the following: the isothermal transverse magnetoresistivity ρ_{11}, the isothermal Hall resistivity ρ_{21}, the (adiabatic) thermoelectric coefficient ϵ'_{11}, the (adiabatic) Nernst–Ettinghausen coefficient ϵ'_{21}, and the transverse magnetothermal resistivity γ_{11}. A rough analysis of the gross effects was made by a decomposition of each coefficient into a sum of different band contributions, each band being approximated by a Lorentz term. General, but not complete, agreement between experiment and theory is achieved for both two-band and multiband models. No special mechanism, as in the case of zinc, is needed to explain the oscillations in the different effects, since the Lifshitz and Kosevitch Theory (σ_{12}), the Zil'berman Theory ($\sigma_{11}, \epsilon''_{11}$), and the influence of oscillation in the density of states (ϵ''_{12}) lead to satisfactory agreement. Author

N63-17054 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.

ELECTRICAL RESISTIVITY OF SEMICONDUCTING DIAMOND Research Report

A. D. Johnson, J. R. Littler, and J. P. Wielhouwer Sept. 1962 24 p 27 refs

(AFCRL-62-561)

Semiconducting diamond with its wide energy gap, favorable current carrier mobility, and good mechanical properties holds promise of being a useful high-temperature semiconductor material. The data covered includes electrical resistivity measured from room temperature to 500° C in an inert atmosphere. Over the lower temperature ranges, below approximately 250° C, the temperature coefficient of resistivity is high, negative, and nonlinear. At the higher temperatures, the coefficient rapidly becomes much smaller. A resistivity minimum is observed between 350° and 400° C. The results reported constitute part of a program involving studies of relationships between defects in the diamond crystal structure and its semiconducting properties. Author

N63-17083 Brown U., Providence, R.I.

INVESTIGATIONS OF SURFACE PROPERTIES OF SILICON AND OTHER SEMICONDUCTORS Final Report, 30 Sept. 1962–31 Jan. 1963

J. A. Dillon, Jr., and R. M. Oman Feb. 1963 32 p 25 refs

(Contract AF 19(604)-5986)

(AFCRL-62-949-(Suppl.))

The photoelectric work functions of atomically clean surfaces of three planes of niobium as measured by the Fowler method are: (111), 4.66 ev; (335), 4.55 ev; (110), 4.33 ev. The work function of ion bombarded surfaces of all three planes is 4.09 ev. The sticking coefficient for oxygen on the clean surfaces is 0.9 and on the ion bombarded surfaces is 0.2. The sticking coefficient for carbon monoxide on these surfaces was found to be at least an order of magnitude lower than the values quoted for oxygen. The work function of ion-bombarded surfaces is found to be dependent on the extent of bombardment for bombardments of less than one minute carried out at 0.20 ma/cm^2. A work function of about 4.7 ev has been observed for a bombardment of 20 seconds on the (335) face. Ion-bombardment etching effects observed on the three planes are similar to those observed on germanium and silicon. Author

N63-17084 Radio Corp. of America. RCA Labs., Princeton, N.J.

INFRARED PHOTOCONDUCTORS Summary Report

M. L. Schultz David Sarnoff Research Center, Dec. 31, 1962 62 p 11 refs

(Contract Nonr-2225(00))

Two lines of research on extrinsic germanium photoconductors are described. Part I deals with an investigation of photoconductors designed to function in the 3- to 5-micron region. For this, germanium-silicon alloys activated with Au^{II} and germanium activated with Co^{II} or Ni^{I} were studied. Germanium activated with nickel appeared to be the best solution, although its peak response is somewhat below 5 μ. Part II treats the behavior of photoconductors using compensated donor levels near the valence band as pseudo-acceptor activators. The lowest levels of gold (25 μ) and cobalt (15 μ) were examined. Promising results were obtained, but further work is required to determine whether advantage can be taken of the possible two or three orders of magnitude increase in lifetime (and consequently in photoconductive gain) which should be available. Author

N63-17116 General Electric Co. Electronics Lab., Syracuse, N.Y.

SOLID STATE MICROWAVE DELAY LINE Final Technical Report

W. Brouillette Mar. 15, 1963 47 p 4 refs

(Contract AF 30(602)-2230)

(RADC-TDR-63-149)

Techniques for broadband generation of sound at microwave frequencies have been developed. Using thin magnetostrictive film and a fine wire with a broadband strip line, delay action was achieved over an 800 mcps band from 1.1 gcps to 1.9 gcps. The theory of reflections and a detailed study of appropriate modes in quartz is discussed, with a method of designing a folded-path delay line. Author

N63-17126 Comitato Nazionale per l'Energia Nucleare. Lab. Nazioneli, Frascati (Italy)

CONNECTION AMONG PARITY, STRANGENESS, AND ISOTOPIC SPIN

R. Gatto Apr. 13, 1963 10 p 9 refs

(*Its* Nota interna 193; LNF-63/22)

Models based on invariance under Lie groups are considered as complete dynamical models for elementary particles. The group invariance generates currents, from which the particle interactions are formed. In such a framework, the possibility of a connection between parity conservation, the conservation of strangeness, and isotopic spin is examined. It is found that the currents imposing either parity conservation or (equivalently) strangeness conservation also have the right isotopic spin character. D.E.R.

N63-17127 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE ORIGIN OF THE ANOMALOUS PHOTOVOLTAIC EFFECT IN ZINC SULFIDE – PHYSICS Technical Report
Frank A. Junga May 1, 1963 88 p 39 refs
(Contract Nonr-222(57))
(LMSC-6-90-63-20)

This study proposes to devise and justify a model (semi-quantitative) to account for the general features of the anomalous photovoltaic effect (APE) in zinc sulfide. It was shown that earlier models failed to account for all features of the APE. By extending Hutson's model and formulating the problem in terms of independent photovoltage generators in each segment of the crystal, one can account for all the features of the spectral response of the APE. The model correctly predicts the shape of the spectral response curve, the wavelengths at which the photovoltage changes polarity, and the general position of the photovoltage maxima. Furthermore, the model predicts the correct dependence of photocurrent on the polarization of light incidence of λ_{OV} and λ_{OR} with temperature and light intensity. It was verified that the photovoltage arises from piezoelectric fields set up by permanent internal strain formed during the growth process. The experiment on single-crystal hexagonal ZnS strengthens these results and ties together the information on direction of crystal growth, pyroelectric effect, and the positive peak polarity. This experiment also verified the calculation of the photovoltage generated in a nonuniformly strained piezoelectric crystal. The main weakness of the model is that the photovoltage depends on the internal strain gradients, quantities that cannot be independently measured. N.E.A.

N63-17129 New York U. Radiation and Solid State Lab., N.Y.
INVESTIGATION FOR CORRELATION OF CHEMICAL AND PHYSICAL PROPERTIES OF PHOSPHORS Final Technical Report, 1 May 1960 to 30 April 1961
H. Kallmann Apr. 1963 94 p refs
(Grant DA-ORD-39)
(AROD-2334-3)

Series of ZnS:Cu/Cl phosphors were prepared in atmospheres of N_2, $N_2 + O_2$ and H_2S, and a series of ZnS:Cu/Al phosphors was prepared in N_2, all under otherwise comparable conditions. Their luminescence properties, infrared response, and some electrical properties are reported. Author

N63-17130 Illinois U., Urbana
RESEARCH OF NATURE OF INTERACTIONS OF DISSOLVED INTERSTITIALS WITH DISLOCATIONS [Technical] Progress Report No. 10, Nov. 16, 1962 to May 15, 1963
P. Bunn, R. Gibala, R. Hoffman, and C. Wert May 17, 1963 3 p 1 ref
(Contract AF 33(616)-6176)

The clustering of O in Nb-O alloys is being investigated by anelastic techniques. The apparatus for the investigation has been built and initial experiments have been performed. A preliminary analysis of the data from these experiments is given. The study of the orientation dependence of the Snoek relaxations in niobium due to oxygen and nitrogen is almost completed. Decrement measurements have been made on several crystals in the [100] and [111] orientations. The solubility of N in α-Ta in equilibrium with Ta_2N has been studied several times with widely divergent results. N.E.A.

N63-17147 National Bureau of Standards, Washington, D.C.
DIELECTRIC CONSTANT OF Cr_2O_3 CRYSTALS
P. H. Fang (NASA. Goddard Space Flight Center) and W. S. Brower Repr. from Phys. Rev., v. 129, no. 4, Feb. 15, 1963 p 1561 9 refs

The dielectric constants of Cr_2O_3 were measured at 25.5° C by a two-terminal substitution method on specimens cut from single crystal. The average dielectric constants thus obtained are: at 1 kc/sec parallel *a* axis 13.3, parallel *c* axis 11.9; at 2 mc/sec parallel *a* axis 13.0, parallel *c* axis 11.8. The dielectric constant for either orientation increased approximately 10^{-3} per 1° C in the temperature interval 298° to 325° K. A small anomaly was observed in the neighborhood of the Néel temperature. Author

N63-17194 European Atomic Energy Community, Brussels (Belgium)
SPECTROMETRY OF REACTIONS (n,α) AND (n,f) BY MEANS OF SOLID STATE DETECTORS (SPECTROMETRIE DES REACTIONS (n,α) ET (n,f) À L-AIDE DE DÉTECTEURS À ÉTAT SOLIDE)
G. Fraysse and A. Prosdocimi Joint Nuclear Res. Center, Geel Estab., Apr. 1963 25 p 16 refs
(EUR-222.f) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 40 Belg. Fr.

An application of surface barrier solid-state detectors is made to the spectrometry of α particles and fission fragments. The characteristics of the reaction B^{10} (n,α) Li^7 are deduced and the reaction Li^6 (n,α) H^3, the emission of α particles by uranium and the thermal neutron induced fission are analyzed. The influence of self-absorption of α and fission fragments on their energy distribution shapes are displayed. Author

N63-17350 Cornell U., Ithaca, N.Y.
RESEARCH ON NEW SOLID STATE DEFECT STRUCTURES BASED ON WO_3 AND ON V_2O_5 Final Report
M. J. Sienko Washington, AF Office of Scientific Res., Solid State Sciences Div., Sept. 30, 1962 12 p 113 refs
(Contract AF 49(638)-191)

An attempt was made to define the current carriers in Cu_xWO_3, their concentration, and their mobility as a function of temperature. As parallel investigation, Ag_xWO_3 and Li_xWO_3 were studied for the same parameters since they, too, had been reported to be semiconductors. The carrier characteristics in M_xWO_3 (M = univalent metal) were almost exclusively determined by the host structure WO_3, so a study of single crystals of WO_3 was initiated. The ultimate results were that, for M_xWO_3, quantitative justification can now be given to the whole range of solid-state properties investigated, for samples. Hall mobility, resistivity, thermoelectric power, magnetic susceptibility, magnetic resonance —both as a function of temperature and as a function of composition. The relatively high mobility of carriers in M_xWO_3 was considered by studying the conduction band in WO_3 that arises from overlap of the $5d(t_{2g})$ orbitals of the tungsten atom. Because the spatial extent of such orbitals decreases as the principal quantum number but increases with decreasing atomic number, it was believed that overlap of the $3d(t_{2g})$ orbitals of vanadium in V_2O_5 might also lead to a conduction band of finite width, as in WO_3. Investigations in this phase are still in progress. N.E.A.

N63-17383 National Bureau of Standards, Washington, D.C.
SIZE-DEPENDENT SPIN RELAXATION TIME
P. H. Fang Repr. from Phys. Rev., v. 129, no. 4, Feb. 15, 1963 p 1548–1459 7 refs

The increase of the paramagnetic relaxation time due to the increase in size of the crystal of copper Tutton salt, reported by Nash, is interpreted from a model of Eisenstein. Author

N63-17388 HP Associates, Palo Alto, Calif.
INVESTIGATION OF HOT ELECTRON EMITTER Scientific Report No. 3, Dec. 1, 1962-Feb. 28, 1963
[1963] 52 p
(Contract AF 19(628)-1637)
(AFCRL-63-113)

The electrical properties of gold–silicon barriers have been studied experimentally. The reverse leakage current of these barriers is shown to be caused by lowering of the barrier due to the image force effect. The thermal activation energy of the saturation current was found to be 0.799 ev, identical to the height of the Au–Si barrier. The barrier height, saturation current density, and ideality of Pt, Pd, Ag, Ni, and Cu barriers to Si are also presented. Two methods for fabricating hot electron triodes are described. Large area structures, made by pressing together a silicon–gold–silicon sandwich, do not exhibit triode characteristics, and are limited by particulate matter and deviations from flatness. Triodes with point-contact emitters of silicon and gallium arsenide have been fabricated, and their current-voltage characteristics are presented. Current transfer ratios as high as 0.75 have been observed. Author

N63-17468 European Organization for Nuclear Research, Geneva (Switzerland)
THE RESEARCH OF MARTENSITE (LA RECHERCHE DE MARTENSITE)
A. H. Achermann Apr. 9, 1963 14 p 2 refs In FRENCH
(CERN-63-11)

The structure of austenitic stainless steel undergoing martensite crystalline transformation, due to repeated exposure to cryogenic liquids, was studied with a Metioscope, an electronic microscope that uses the emission of secondary electrons from the sample under ionic bombardment. A series of photographs are presented showing grain boundary disorganization in stainless steel samples after ten and twenty liquid-hydrogen baths, and crystal reorganization during progressive heating of the samples after liquid-hydrogen cycling. It is concluded that this type of microscope will be most useful in metallurgical research to solve the problems of constructing cryogenic equipment. Trans. by M.P.G.

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-17006 Israel Program for Scientific Translations, Ltd., Jerusalem
CHEMISTRY AND TECHNOLOGY OF SYNTHETIC LIQUID FUELS (ISKUSSTVENOE ZHIDKOE TOPLIVO (KHIMIYA I TEKHNOLOGIYA))
I. B. Rapoport 1962 432 p Transl. into ENGLISH Second Edition
(IPST Cat. No. 599; OTS 61-31075) OTS: $4.25

The book deals with the following problems of chemistry and technology of synthetic liquid fuels: destructive hydrogenation of solid and liquid fuel; conversion of hydrogenation products into high-quality liquid fuel; synthesis of motor fuel from hydrogen and carbon monoxide; the effect of temperature, pressure, catalyst, composition and purification of starting gas on the processes of hydrogenation and synthesis; conversion of synthesis products, their composition and quality. Author

N63-17389 Southwest Research Inst., San Antonio, Tex.
STUDIES OF INTERNAL DISPLACEMENTS IN SOLID PROPELLANT GRAINS (LONGITUDINAL DISPLACEMENTS IN FREE-STANDING, SOLID PROPELLANT HOLLOW CYLINDERS) Interim Report
L. U. Rastrelli and R. C. De Hart Mar. 1, 1963 15 p 3 refs
(Contract Nonr-3363(00)(FBM))

Deformation of the subsurface material in viscoelastic thick-walled cylinders is studied. Measurements of internal displacement were obtained for two solid-propellant models, with embedded and surface mounted particles, by subjecting the models to simple mechanical loading. This loading consisted of uniaxial compression or a combination of uniaxial compressions and internal pressure for a period of twenty-four hours. C.L.W.

N63-17390 Southwest Research Inst., San Antonio, Tex.
STUDIES OF INTERNAL DISPLACEMENTS IN SOLID PROPELLANT GRAINS (EVALUATION OF PHENOMENOLOGICAL RELATION FOR VISCOELASTIC MATERIALS) Interim Report
E. Z. Stowell, L. U. Rastrelli, and B. J. Pape May 31, 1963 31 p 6 refs
(Contract Nonr-3363(00)(FBM))

The phenomenological relation between stress, strain rate, and temperature in describing the behavior of viscoelastic materials and solid propellants is discussed. Test data were gathered to provide the necessary material constants and to permit an evaluation of the range of applicability of the relation. The basic equation formulated by Stowell to predict the behavior of viscoelastic materials under various time and temperature conditions is given; and the relations between stress-strain, creep, stress relaxation, increasing temperatures, and periodic stress are calculated within this framework. D.E.R.

N63-17391 Bureau of Mines. Explosives Research Lab., Pittsburgh, Pa.
INITIATION OF DETONATION BY LOW AMPLITUDE SHOCKS Quarterly Report, Feb. 1, 1963-Apr. 30, 1963
F. C. Gibson, R. W. Watson, C. R. Summers, F. H. Scott, and E. J. Hay May 28, 1963 21 p
(ARPA Order 44-63)

Research was conducted in the field of initiation and growth of detonation in explosives and propellants. Particular emphasis was placed on reactions resulting from initiation by low-amplitude shocks of a liquid explosive, and the behavior of the explosive between shock application and subsequent reactions. A pressure transducer was used for these studies, which consisted of a resistive element imbedded in a polyethylene rod that was immersed in the liquid to a predetermined level. The arrival of a precursor shock at the transducer was followed by a period of about 50 microseconds during which there was no pressure-producing reaction. After this interval a second shock of greater magnitude arrived. These data do not appear to be consistent because changing the position of the transducer during the interval influences the characteristics of subsequent reactions. C.L.W.

N63-17430 Atlantic Research Corp., Alexandria, Va.
STUDY OF ELECTRON GENERATION BY SOLID PROPELLANT TECHNIQUE
R. Friedman, L. W. Fagg, T. K. Millar, W. D. Charles, and M. C. Hughes Sept. 21, 1962 17 p 10 refs
(Contract AF 49(638)-651; AF 19(628)-295)

Electron generators functioning by combustion of a cesium nitrate-aluminum pressed charge have been developed and test-fired in an altitude chamber. Thermodynamic analysis of the

combustion and nozzle expansion process shows that about 10^{20} electrons are discharged per gram of charge, the gaseous product containing about 2 mole percent electrons. Spectroscopic measurements of the exhaust plume at 40 mm Hg abs confirm electron concentrations of this magnitude via Stark-broadening of cesium emission lines. Details of generator operation are given, and alternate chemical systems for electron generation are discussed. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-16995 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
POSSIBLE EFFECTS OF NONUNIFORM FLOWS ON PERFORMANCE OF ELECTROTHERMAL THRUSTORS
John R. Jack and John W. Schaefer Washington, NASA, June 1963 17 p 5 refs
(NASA TN D-1732) OTS: $0.50

The effects of a nonuniform enthalpy profile on the performance of an electrothermal thrust generator are evaluated analytically. Performance characteristics are presented for uniform specific impulses ranging from 1000 to 2000 seconds, pressures of 0.01 to 100 atmospheres, and engine wall temperatures of 500° and 3000° K. The nonuniform profile changes the uniform specific impulse by 10 percent at most (except for simulated starting conditions), and the change can either be helpful or detrimental, depending upon the specific operating conditions. In general, an increase in the engine wall temperature causes the specific impulse to approach the uniform flow value. A very special nonuniform profile was also considered, one that may represent the startup of a cold engine. The magnitude of its effect on engine performance may be quite large, the variance depending on the operating conditions. Author

N63-17016 Aerojet-General Corp., Downey, Calif.
EXPLOSIVE FORMING OF CLOSURES FOR LARGE SOLID PROPELLANT MOTOR CASES Quarterly Progress Report No. 4, 17 Jan. 1963-17 Apr. 1963
A. W. Hall and I. Lieberman Apr. 30, 1963 55 p
(Contract AF 04(611)-8395)
(Rept. 0665-01(04)QP)

The initial results of closure contours as affected by variations in explosive configuration are presented in this report. Formability of 18% nickel maraging steel, and the weldability of this material by explosive pressures are also briefly described. Author

N63-17026 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRIC PROPULSION. STATE OF THE ART – 1962
Ernst Stuhlinger Repr. from Astronautics, Nov. 1962 p 60–67 5 refs

Current research in electrothermal, electrostatic, electromagnetic, heavy-particle, and electric space power supply systems is summarized. It is found that the electric propulsion concept has reached the stage of development that requires engineering refinement, reliability testing, space testing, and mission planning. It is recommended that flight testing of electrical systems begin immediately and that nuclear-electric propulsion systems be developed. D.E.R.

N63-17166 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ALL SOLID-PROPELLANT INJECTION VEHICLES FOR LARGE-PAYLOAD SPACE MISSIONS. APPLICABILITY OF SOLID PROPELLANTS TO HIGH-PERFORMANCE ROCKET VEHICLES
M. Summerfield, J. I. Shafer, H. L. Thackwell, Jr., and C. E. Bartley Repr. from Astronautics, Oct. 1962 p 37–56 6 refs
(NASA Contract NAS7-100; Contract W-04-200-ORD-455)
(JPL-TR-32-352)

Studies of large-scale vehicles (capable of placing at least 500,000 lb into earth orbit) based on all-liquid and all-solid propulsion systems have revealed the following conclusions: (1) Vehicle system reliability will probably prove to be unacceptably low for complex manned space missions if development programs are based on the philosophy and program approaches used in the past; (2) a design and development philosophy which advocates unusual conservatism and design within the state of the art leads to the desired high reliability; (3) with this philosophy, and unique characteristics of an all-solid rocket, a basically new approach to early high reliability of flight vehicles becomes possible; program implementation would consist of early evaluation of the motor designs, vehicle structure, and flight dynamics in scale-model tests, followed by assembly of the scaled-up, full-sized components as a complete vehicle for immediate use; (4) all-solid-propellant injection vehicles of 25- to 35-million-lb launch weight are feasible; when compared with liquid or hybrid-stage vehicles of comparable capability, the development risk would be very low, and the resultant vehicle reliability at an early date unusually high—provided suggested philosophy and program approach were utilized; (5) schedules and costs for all-solid injection vehicles studied are significantly lower than for hybrid-stage and liquid propellant vehicles of comparable payload capability; and (6) by replacing solid upper stages with liquid-hydrogen–liquid-oxygen stages as these become available, the growth potential of all-solid vehicles is favorable for space missions which require large payloads and high sophistication. N.E.A.

N63-17184 Ion Physics Corp., Burlington, Mass.
STUDIES OF A LEWIS TYPE BOMBARDMENT ION ENGINE
H. J. King and B. S. Quintal [1963] 6 p 6 refs Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Colo., Mar. 11–13, 1963
(NASA Contract NAS8-1684)
(AIAA Paper-63030A-63) AIAA: $0.50 members, $1.00 nonmembers

An experimental program has been conducted to investigate the performance of a Lewis type electron-bombardment ion engine. It has been found that, depending on the fixed operating parameters, either the arc density or the beam-forming electrode geometry limits the allowable output current. A similar type of operation was found for engines varying in diameter by a factor of three, indicating that the engine size may be scaled if required to produce a particular output thrust or to match the power output of a generator. Thrust pulses of duration 50 msec have been produced with a rise time of the order of 10 μsec by pulsing the arc voltage. No deleterious effects are observed as a result of operating the engine in a pulsed mode. Author

N63-17185 Plasmadyne Corp., Santa Ana, Calif.
RESULTS OF SATELLITE RAISING AND ORBIT TRANSFER STUDIES FOR LOW POWER ELECTROTHERMAL ARC-JET PROPULSION SYSTEM

Frederic E. Marchand, Paul D. Arthur, and Owen J. Mc Caughey [1963] 15 p 4 refs Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Colo., Mar. 11–13, 1963
(NASA Contract NAS8-2544)
(AIAA-Paper-63010) AIAA: $0.50 members, $1.00 nonmembers

Low-power electrothermal arc-jet engines in the one- to three-kilowatt range are currently under development. Solar panel–battery power supplies are also under development at power levels up to several kilowatts, and can be made available at an early date for space-vehicle applications. These engine-power supply combinations will have a great many potentially valuable space-vehicle applications. Several applications have been investigated analytically, including satellite raising and orbit transfer, drag makeup, attitude control, station-keeping, and trajectory control. This paper considers only the satellite raising (or orbit transfer) applications of such engines. Advantages and disadvantages of using solar panel–electrothermal propulsion for satellite raising are briefly discussed, and parametric mission-study methods and results are reported for a specific mission of raising a satellite from an inclined parking orbit (AMR launch) to a synchronous equatorial orbit. Effects of independently varying the following parameters were investigated: propellant type (hydrogen and ammonia), engine power level, power-supply specific weight, thruster specific impulse, and payload. Ascent time and parking-orbit altitude were the dependent variables. Arc-jet engine design and development goals, in terms of propellant type, power level, and specific impulse, are optimized for the specified mission. Results indicate an optimum power level between 1.5 and 3 kw, based on projected power-supply specific weights, and further indicate potential advantages of ammonia over hydrogen as the propellant, provided required engine life can be obtained. Principal potential advantage of ammonia over hydrogen is the much shorter ascent time required, while principal disadvantage involves the more severe thruster-development problems. Criteria are suggested for selecting design and development goals for engine specific impulse. Author

N63-17227 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NUCLEAR PROPULSION. STATE OF THE ART – 1962
Harold B. Finger (NASA, Wash., D.C.) and Frank E. Rom Repr. from Astronautics, Nov. 1962 p 90–91

Progress in the development of a nuclear propulsion system for use with a rocket engine is summarized, including the development of: the reactor test program and the Kiwi-B tests, facilities, propellant tests, environmental tests for components and engine systems, the Nerva engine, and the Rift project. D.E.R.

N63-17258 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ELECTRIC PROPULSION REQUIREMENTS FOR PLANETARY AND INTERPLANETARY SPACECRAFT
John W. Stearns 6 p 6 refs Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Colo., Mar. 11–13, 1963
(NASA Contract NAS 7-100)
(Paper 63038)
(AIAA-Paper 63038) AIAA: $0.50 members, $1.00 nonmembers

Assumptions are made concerning the nature of scientific payloads required for planetary exploration missions, and the minimum weight of spacecraft necessary to deliver the scientific payload to its destination in deep space. A single, basic spacecraft design with relatively small variation of propellant loading could perform at least nine separate planetary and interplanetary scientific missions beyond Venus and Mars. In addition, with only slight modifications to the basic electric-propulsion spacecraft, it is possible to achieve second-generation orbital missions to Venus and Mars. This spacecraft can use a two-stage Saturn B as a launch vehicle. The parameters for such a mission program are discussed. A 500-kwe powerplant is defined. Ultimate goals for a second-generation nuclear-electric spacecraft are anticipated, and basic scheduling criteria are established. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-16987 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ASCENT FROM THE LUNAR SURFACE
Rowland E. Burns and Larry G. Singleton Washington, NASA, June 1963 155 p 5 refs
(NASA TN D-1644) OTS: $3.00

The problem of three-dimensional optimal ascent from the lunar surface is discussed using the techniques of variational calculus. The moon is assumed to be spherical and rotating, perturbational effects from all other bodies are neglected. Final orbital inclination is calculated under the assumption that the angular displacement of the moon during ascent is negligible. Only single-stage vehicles are considered, and are subdivided into propellant and mass in orbit. Both thrust and mass-flow are assumed constant throughout the powered flight of a given vehicle. The technological range considered covers specific impulse values of 300 sec. to 450 sec (in steps of 50 sec), and lunar thrust-to-weight ratios of 1 to 7 (in steps of 1). Initial lift-off angles vary from 0° to 40° (in steps of 10°). Most results assume a launch site on the lunar equator at the lunar prime meridian, and a final orbital inclination of 5°. In each case, the thrust and velocity vectors are alined at cutoff. Sample cases deal with launch latitudes of 30° and 60°, while other calculations show the effects of varying final inclination from 0° to 180°. The results present mass fraction in orbit and final orbital altitudes as well as the initial values of certain mathematical functions (Lagrange multipliers) necessary to attain these end conditions. Optimum values of initial thrust-to-weight ratios and orbits of maximum mass fraction are described for each combination of specific impulse and lift-off angle. These results are presented both tabularly and graphically; several examples illustrate applications to preliminary design studies. Author

N63-17104 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRON LOSS RATE FROM THE OUTER RADIATION BELT
S. Bloom, L. Mann, F. Seward, M. West (Calif. U.), and W. N. Hess [1962] 21 p 18 refs Presented at the COSPAR Meeting, May 1962
(NASA TM X-50017; NASA X-640-62-38) OTS: $2.60 ph, $0.83 mf

From low altitude measurements on the outer belt electrons by Discoverer satellites, a calculation of the rate of loss of particles from the outer radiation belt is presented. These results were compared with experimental measurements from other satellite data. Three separate groups of electrons were observed on the Discoverer flight: (1) the (A) spectrum which

falls off sharply with energy and does not extend above 125 Kev; (2) the (B) spectrum, which is the spectrum of auroral electrons; and (3) the (C) spectrum which looks rather like a neutron beta-decay spectrum except extending to higher energies. Most of the electrons in the radiation belt are of the (C) spectrum type. These are lost from the radiation belt by coulomb scattering. The average resident time of an electron in the outer radiation belt is calculated, on the basis of coulomb scattering, to be 3×10^9 sec and is measured to be considerably longer than 0.4×10^7 sec. The results are probably good to a factor of ×5. The data on the (C) spectrum electrons concerning their energy spectrum, loss rate, and lifetime are all consistent with these particles being the result of neutron decay. These particles constitute most of the inner and outer radiation belt electron. N.E.A.

N63-17113 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMIC RAY OBSERVATIONS IN SPACE
D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. Mc Donald *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 149–168 13 refs (See N63-17105 15-29) OTS: $3.50

The Explorer XII cosmic-ray experiment is described, and measurements made during the solar event of September 28, 1961, are discussed. Galactic cosmic-ray measurements are also reported. A few hours before the class 3 flare of September 28, two short counting-rate increases were observed, and these have been interpreted as electron bursts. The anisotropy of the solar protons is described. It is found that the history of the intensity of the solar protons is consistent with their having diffused through interplanetary space with an effective mean free path of 0.04 AU. An estimate of the distance from the sun at which diffusion becomes unimportant and particles escape gives 2 to 3 AU. Simple diffusion does not account for the anisotropy observed early in the event. Two days after the flare, there was a large increase in the intensity of protons with energies less than 15 Mev. As most of these particles, which have been called "energetic storm particles," arrived after the sudden commencement, it is suggested that they were solar protons trapped within the plasma cloud which caused the magnetic storm. A possible trapping mechanism is outlined. Explorer XII measurements of the Forbush decrease of September 30, 1961, are compared with neutron monitor measurements at Deep River. The decrease is larger at Explorer XII by a factor of 1.7 ±0.3. Author

N63-17115 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMIC RAY EXPERIMENTS FOR EXPLORER XII [1961 ν] AND THE ORBITING GEOPHYSICAL OBSERVATORY
George H. Ludwig and Frank B. Mc Donald *In its* Goddard Space Flight Center Contributions to the COSPAR Meeting, May 1962 May 1963 p 223–235 4 refs (See N63-17105 15-29) OTS: $3.50

The cosmic-ray experiment on Explorer XII consisted of a Geiger-counter telescope, a thin *CsI* scintillation counter, and a large-area scintillation-counter telescope. The thin scintillation counter was connected to an 8-level integral analyzer. The large-area scintillation-counter telescope, which measured the energy loss of the detected particle, was fed to a 32-channel differential pulse-height analyzer with a storage capacity of 65,535 counts per channel. Both the Geiger-counter telescope and single counter rates were telemetered. All information was multiplexed onto a single channel. Details of the instrumentation and the methods of encoding are discussed. For the first Orbiting Geophysical Observatory mission, a new scintillation-counter telescope has been developed which measures both energy loss and total energy. This furnishes excellent charge and energy resolution over an energy range from about 11 to 90 Mev per nucleon. Design details of this telescope and its associated electronic instrumentation are also presented. Author

N63-17168 Naval Research Lab., Washington, D.C.
MEASUREMENTS OF THE 4.3-MM RADIATION OF VENUS
C. R. Grant, H. H. Corbett, and J. E. Gibson Repr. from Astrophys. J., v. 137, no. 2, Feb. 15, 1963 p 620–627 21 refs

Observations were made of the 4.3-mm radiation from Venus over a period from 40 days before to 54 days after the inferior conjunction of April 11, 1961. The mean brightness temperature at this wavelength was 350° K, with an uncertainty of +50° and −30° probable error. The observations did not indicate a trend toward variation with phase. Author

N63-17171 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
PROTECTION AGAINST SOLAR FLARE PROTONS
Trutz Foelsche Repr. from Advances in the Astronautical Sci., v. 8, 1962 p 357–374 39 refs

Mass shielding requirements are estimated for flight during extreme flare-proton events in the distant environment of the earth. Chosen as examples for calculation of doses behind different amounts of shielding are the high-energy event on February 23, 1956, the low-energy extreme flux events from May 10 and July, 1959, and the high-flux event of August 22, 1958. Estimates are based on the spectra and their variations given by J. R. Winckler, D. K. Bailey, K. A. Anderson, R. Arnoldy, R. A. Hoffman, and L. Peterson, on the basis of sea-level, balloon, ionospheric, and space-probe observations during solar proton events. Author

N63-17200 Iowa State U., Iowa City
REVIEW OF STUDIES OF TRAPPED RADIATION WITH SATELLITE-BORNE APPARATUS
B. J. O'Brien Repr. from Space Sci. Revs. (Dordrecht), v. 1, 1962–1963 p 415–484 refs
(NASA Grant NsG-233-62)
(NASA CR-50284)

Parameters involved in studies of the geomagnetically trapped radiation are discussed. A historical outline of the advance to the present knowledge is given briefly, including experiments made from 1957 to 1961. The principal scientific and technical references for each experiment are listed, together with an indication of the energy ranges and types of the detectable particles. Only successfully launched experiments are included. A brief account of the current experimental knowledge of the radiation zone is given. Radiation environment changes created after the nuclear explosion, at high altitude, on July 9, 1962, are described. Many ground-based observations of the radiation zones are given. A few requirements for an experimental study of the radiation zones are presented. N.E.A.

N63-17312 Geophysics Corp. of America, Bedford, Mass.
PLANETARY AERONOMY VII: THE SOLAR FLUX INCIDENT AT THE TOP OF THE ATMOSPHERES OF EARTH AND NEIGHBORING PLANETS FOR THE SPECTRAL REGION 50 A TO 3000 A
E. D. Schultz and A. C. Holland Nov. 1962 36 p 5 refs
(NASA Contract NASw-395)
NASA CR-11), (GCA-TR-62-14-N OTS: $3.60 ph, $1.28 mf

The solar flux incident at the top of the Earth's atmosphere has been compiled for the spectral region 50 A to 3000 A. Between 50 A and 1850 A, the major emission lines were distinguished from the continuum and are presented separately. The continuum and weak lines are lumped together. The pure

experimental data are plotted in two clear and unambiguous presentations of the tabulation to provide a convenient comparison of the contribution of major emission lines with the contribution of the continuum and weak lines. To obtain the flux values at the top of the atmospheres of neighboring planets, intensity dilution factors are easily determined using an inverse square relation based on mean radius vector magnitudes. The tabulated data for Earth were used as a base to generate the entire model of the solar photon flux from 50 A to 3000 A for the top of the atmosphere of Venus and Mars.
N.E.A.

N63-17330 Minnesota U. Cosmic Ray Group, Minneapolis
THE MEASUREMENT OF THE CUTOFF RIGIDITY AT MINNEAPOLIS USING SOLAR PROTONS AND α PARTICLES FROM JULY 10, 1959, FLARE
Phyllis S. Freier Repr. from J. Geophys. Res., v. 67, no. 7, July 1962 p 2617-2626
(NASA Contract NASw-56; Nonr-710(19))
(CR-48)

The integral energy spectra of solar protons and α particles were obtained during six balloon flights in the three days following the solar flare of 0210 ut, July 10, 1959. Two of the flights occurred at Fort Churchill, Canada, where the cutoff rigidity imposed by the earth's magnetic field was very much less than the cutoff imposed by the air above the balloon. Therefore, in these two flights the measured energy spectra were those existing in the solar beam. In the four flights at Minneapolis, the measured energy spectra represented the spectra in the solar beam modified by the earth's magnetic field. From an analysis of both the counter results already reported, and the emulsion results, the time variation of the cutoff rigidity at Minneapolis has been obtained. The quiet time cutoff at Minneapolis was 1.2 bv, but showed a sharp decrease even before the sudden commencement of the magnetic storm that followed the flare. During the magnetic storm, the cutoff rigidity was reduced to 0.7 bv or less. In the rigidity interval 0.8 to 1.0 bv, the abundance of protons to α particles was 1.4 from 30 to 38 hours after the flare. The α-particle flux decreased faster than the proton flux, and 59 to 70 hours after the flare the proton-to-α-particle ratio was 5. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-16985 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LONG-PERIOD MOTION OF THE TROJANS, WITH SPECIAL ATTENTION TO THE THEORY OF THUERING
Karl Stumpff Washington, NASA, June 1963 17 p 7 refs
(NASA TN D-1416) OTS: $0.50

In 1930, B. Thuering published an approximative theory of long-period motion of the Trojans as a restricted three-body problem. With this theory the periodic orbits for all amplitudes can be approximated so that the remaining deviations are at most of the order of the mass of Jupiter ($<10^{-3}$). Thuering's solution provides a starting point for an exact theory of the plane long-period Trojan orbits according to the method of the variation of constants. Special attention is devoted to the borderline case, in which the periodic orbits around L_4 and L_5 overlap. This boundary orbit and its adjacent orbits run into the infinitesimal Charlier orbits around L_3 —more specifically, into those of the hyperbola type. Author

N63-16993 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LUNAR FLIGHT STUDY SERIES: VOLUME 5. TRAJECTORIES IN THE EARTH-MOON SPACE WITH SYMMETRICAL FREE RETURN PROPERTIES
Arthur J. Schwaniger Washington, NASA, June 1963 29 p 6 refs
(NASA TN D-1833) OTS: $0.75

An extensive investigation has been made of the characteristics of so-called "free return" trajectories. For the purposes of the study, these trajectories are defined as having symmetric properties which afford flight to the vicinity of the moon and return to earth without need for propulsion after the initial boost phase. The restricted three-body model for the earth-moon probe system is used throughout. Two kinds of free return trajectories are shown to exist and are studied. Of particular interest is the fact that for one kind of free return path, the largest inclination which can be achieved between the flight plane at periselenum and the plane of the moon's orbit about earth is about 10.8°, whereas for the other kind of path, the largest possible inclination is dependent on the radius at periselenum. In this case the inclination is limited to about 14° or less for periselenum radius of 1938 km, but may be as great as 90° with periselenum radius of 21,150 km. Trajectories are also demonstrated which pass in front of the moon. These exhibit inclination behavior very much like that given by trajectories which go behind the moon. The injection velocity for these trajectories also changes only slightly from the circumlunar trajectories (less than 2 m/s for periselenum radius of 1938 km). However, the position of injection is changed considerably, and the flight time may be increased by as much as five times that for circumlunar flights. Author

N63-17003 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-20, VOLUME VI FOR THE PERIOD JANUARY 1, 1963 TO MARCH 31, 1963. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
Apr. 30, 1963 158 p 33 refs
(NASA Contract NAS7-100)
(JPL Space Programs Summary 37-20, Vol. VI) OTS: $11.50 ph, $4.94 mf

Activities reported on the space exploration program are discussed in the following areas: (1) lunar program; (2) planetary-interplanetary program; (3) deep-space instrumentation facilities—communication; (4) operational and test facilities—spaceflight operations facilities, and test and support equipment; (5) space science—lunar and planetary studies. N.E.A.

N63-17010 Instituto y Observatorio Astronomico de Marina, San Fernando (Spain)
ASTRONOMICAL ALMANAC. MAY, JUNE, JULY, AUGUST, 1963 (ALMANAQUE AERONAUTICO. Mayo-Junio-Julio-Agosto, 1963)
1963 266 p In SPANISH

The almanac contains astronomical data for the Sun, Moon, Venus, Saturn, Jupiter, and selected navigational stars, including Polaris, Canapus, Rigel, Regulus, and Vega. J.A.J.

N63-17049 Naval Research Lab. Atmosphere and Astrophysics Div., Washington, D.C.
SPACE PHYSICS

Herbert Friedman *In* Advisory Group for Aeronautical Research and Development, Paris (France) Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961 [1961] p 39–52 (See N63-17048 15-01)

Contributions to the study of space physics within the last ten years are summarized, with emphasis on: ionospheric studies, space probes, van Allen belt system, cosmic rays, and X-ray and ultraviolet spectroscopy. D.E.R.

N63-17105 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE COSPAR MEETING, MAY 1962

Washington, NASA, May 1963 231 p 320 refs A collection of papers presented at the COSPAR Third Intern. Space Sci. Symp., Washington, D.C.

(NASA TN D-1669) OTS: $3.50

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N63-17133 California Inst. of Tech. Div. of Geological Sciences, Pasadena

SURFACE TEMPERATURE VARIATIONS DURING THE LUNAR NIGHTTIME

Bruce C. Murray and Robert L. Wildey May 17, 1963 45 p 30 refs Submitted for Publication

(NASA Grant NsG-56-60)

(NASA CR-50148) OTS: $4.60 ph, $1.55 mf

Observations of the 8- to 14-micron thermal emission into the first 160 hours of the lunar nighttime of the moon are described in full. The evidence of both horizontal and vertical variations in thermal properties of the lunar surface is discussed. It is also pointed out that these observations, along with other recent radar observations, are strongly suggestive of surface redistribution processes presently active on the lunar surface. N.E.A.

N63-17152 Harvard Coll. Observatory, Cambridge, Mass.

THE ATMOSPHERE OF MARS

D. H. Menzel [1963] 4 p Repr. from Mem. Soc. Roy. Sci. Liège, ser. 5, v. 7, special issue

(NASA Grant NsG-89-60)

(NASA CR-50016; *Its* Repr. 614)

General conclusions concerning the atmosphere of Mars are presented with particular emphasis directed to the water vapor content it is capable of condensing out to form liquid or crystal fogs. It was concluded that the atmosphere of Mars contains two layers of particulate matter, a thick layer of large dust particles near the surface, and a very thin layer of fine particles above the layer of dust. It was implied that this upper layer consists of fine ice crystals. This suggestion is consistent with the association between the thin atmospheric clouds and the underlying polar caps. N.E.A.

N63-17208 Rensselaer Polytechnic Inst., Troy, N. Y.

PHOTOCHEMICAL PROBLEMS OF THE VENUS ATMOSPHERE

Paul Harteck, Robert R. Reeves, Jr., and Barbara A. Thompson Washington, NASA, June 1963 42 p 46 refs

(NASA Grant NsG-261-62)

(NASA TN D-1984) OTS: $1.25

In an experimental investigation of the possible chemical composition of the atmosphere of Venus, a series of conditions which may exist on Venus have been simulated. Experimental measurements were made of the absorption coefficients of carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O_2), and other gases in the region from 1850 A to longer wavelengths. The behavior of CO_2 under the impact of ionizing radiation from pressures of 1 atmosphere down to a few hundred microns was studied, and extrapolation made to the region of chemosphere. Reaction mechanisms which may occur and be of major importance in the Venus atmosphere are discussed. As an alternate to the currently popular thermal origin of the observed microwave radiation emitted from Venus, a chemical source is suggested. Light-emitting chemical reactions of the type believed to occur on Venus are discussed. Preliminary results show that microwave radiation in the 3-cm wavelength region is emitted from the CO_2 discharge. Author

N63-17214 Jet Propulsion Lab. Calif. Inst. of Tech., Pasadena

DIRECT-ASCENT vs PARKING-ORBIT TRAJECTORY FOR LUNAR-SOFT-LANDING MISSIONS

T. F. Gautschi and V. C. Clarke, Jr. Dec. 3, 1962 38 p refs (NASA CR-50064; JPL-TM-33-114) OTS: $3.60 ph, $1.34 mf

Differences between direct-ascent and parking-orbit modes of transit to the moon and their effects on a lunar-landing mission are studied within the context and constraints of the Surveyor Project. Constraints considered (at both "current" and "minimum" levels) include lunar lighting, launch-window duration, landing location, launch azimuth, launch vehicle capability, transit time, observability of landing from earth, launch opportunities per period, and desired mission frequency. A listing of advantages and disadvantages provides some basis for conclusions. Source material and amplification, together with a glossary of terms, are given. Author

N63-17216 California Inst. of Tech. Div. of Geological Sciences, Pasadena

INFRARED PHOTOMETRIC MAPPING OF VENUS THROUGH THE 8-14μ ATMOSPHERIC WINDOW

Bruce C. Murray, Robert L. Wildey, and James A. Westphal May 13, 1963 15 p 13 refs Submitted for Publication

(NASA Grant NsG-56-60; NSF Grant 25210)

(NASA CR-50149) OTS: $1.60 ph, $0.80 mf

High resolution brightness-temperature contour maps for the planet Venus, on four nights surrounding the Mariner II encounter with the planet, are constructed. These maps are analyzed and preliminary results are presented. The general decrease in brightness from the planet's center to limb is dependent on the angle and local vertical of the specific intensity vector that characterizes the emergent radiation field. There is an absence of a strong night-to-day effect in the infrared emission, suggesting that the temperature of the atmospheric layers is independent of the diurnal insulation variation. There are energy redistribution mechanisms rendering a major fraction of the planet's energy loss insensitive to diurnal variation, including the bilateral symmetry of the brightness-temperature contours and the absence of a night–day effect in infrared emission. The "storm" zone in Venus' southern hemisphere was observed but more observations are recommended before they are interpreted. D.E.R.

N63-17226 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PRELIMINARY RESULTS FROM MARINER-II SOLAR PLASMA EXPERIMENT

Marcia Neugebauer and Conway W. Snyder Nov. 15, 1962 11 p 11 refs

(NASA Contract NAS7-100)

(NASA CR-50065; JPL-TM-33-111) OTS: $1.60 ph, $0.80 mf

This memorandum presents a preliminary summary of the data received from the Mariner-II solar plasma experiment for the period August 29 through October 31, 1962. During this period, there was always a measurably large plasma flow from the direction of the sun. The velocity of this ion motion was generally in the range 400 to 700 km/sec. Time variations, plasma desnity, and ion temperature are also discussed. Author

N63-17236 National Aeronautics and Space Administration, Washington, D.C.

THE NATIONAL SIGNIFICANCE OF THE AUGMENTED PROGRAM OF SPACE EXPLORATION

Hugh L. Dryden [1962] 11 p

The impact of scientific and technological developments on human affairs; the beginning of space exploration; aims and objectives of the U.S. space program; manned lunar flights; and the significance and impact of the accelerated U.S. space program are discussed. N.E.A.

N63-17262 Electro-Optical Systems, Inc., Pasadena, Calif.

THE FIRST FLIGHT TOWARD THE PLANET MARS. SOVIET SCIENCE IN THE NEWS Report No. 1

Jan. 18, 1963 20 p Transl. into ENGLISH from Pravda (Moscow), Dec. 15, 1962

Interplanetary station "Mars I," launched toward the planet Mars by the Soviet Union on November 1, 1962, is discussed. A calculation of the spacecraft's flight by the given trajectory measurement indicates that "Mars I" will pass within 193,000 km from the surface of the planet Mars. A description of the structure of the spacecraft is presented, and the scientific instruments, research objectives, radio communications, and data storage are discussed. J.A.J.

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-16991 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL RANGE ATTAINABLE BY THE CONSTANT-ALTITUDE VARIABLE-PITCH REENTRY MANEUVER INITIATED AT VELOCITIES UP TO ESCAPE VELOCITY

E. Brian Pritchard Washington, NASA, June 1963 80 p 10 refs (NASA TN D-1811) OTS: $2.00

The vehicles considered operate on Newtonian drag polars and vary in maximum lift-drag-ratio capability from 0 to 2, and vehicle ballistic parameter from 10 to 200 pounds per square foot. The maneuver altitude variation was 150,000 to 240,000 feet. Considerably longer ranges are shown to be available if the constant-altitude maneuver is controlled by pitch variation rather than by roll variation with the vehicle trimmed at maximum lift-drag ratio. The angle-of-attack rates required are defined. For a maximum lift-drag ratio less than 0.8, a good approximation to the attainable range is obtained by assuming an elliptic variation of drag coefficient with time. Author

N63-17179 Canadian Armament Research and Development Establishment, Valcartier

THE EFFECTS OF STATIC STABILITY, PITCH DAMPING, ROLL RATE AND TRIM ANGLE ON THE RE-ENTRY MOTION OF A HYPOTHETICAL NOSE CONE

R. Montgomery Apr. 1963 30 p 7 refs

(ARPA Order 133)

(CARDE-TN-1559/63)

The reentry motion of a hypothetical conical reentry vehicle was the subject of a computer study in which particular attention was paid to the amplitude of the angle-of-attack oscillations. For rolling and nonrolling cases, over a wide range of postulated stability characteristics, satisfactory convergence of the oscillation was obtained in all cases. Specifically, the angle of attack always subsided to the trim angle at an altitude substantially above that for maximum dynamic pressure. In no case was divergence or roll-yaw resonance observed. Author

N63-17406 Aerospace Corp., Los Angeles, Calif.
PILOT SAFETY AND MERCURY/ATLAS
Bernard A. Hohmann *In* NASA. Manned Spacecraft Center, Houston, Tex. Manned Orbital Operations Spec. Section [1963] p 40–42 (See N63-17401 15-32)

The program to design and develop the necessary systems to permit the Mercury astronauts to escape from the launch vehicle–spacecraft combination on abort are reviewed. The design reliability, quality assurance, end-product excellence, reliability augmentation, test-site operations, and future applications of the program are studied. D.E.R.

N63-17410 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FLIGHT AND GROUND CREW OPERATIONS – PREFLIGHT CREW OPERATIONS
Donald M. Corcoran *In its* Manned Orbital Operations Spec. Section [1963] p 68–70 (See N63-17401 15-32)

The preflight operations performed on the Mercury capsule at Cape Canaveral are discussed. The many examinations and functional tests often repeated on the spacecraft are reviewed, and it is found that the checkout procedure embodies: (1) the building-block approach to testing, (2) the use of end-to-end testing, (3) the isolation and functional verification of all redundancies, (4) interface testing and verification, (5) the duplication of mission profiles, and (6) the use of the astronaut as an integral part of the system during tests. D.E.R.

N63-17411 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
OPERATIONS – FLIGHT CONTROL AND MONITORING AND RECOVERY
Sigurd A. Sjoberg *In its* Manned Orbital Operations Spec. Section [1963] p 70–74 (See N63-17401 15-32)

The basic functions of the flight control and monitoring and recovery teams for present and future spaceflight programs are: (1) to increase flight safety and mission performance by providing the spacecraft crew with sources of information and data from the ground and (2) to control and direct unmanned flights required in manned spaceflight programs. The recovery team is responsible for getting the astronaut back from flight safely. The flight support team for the Mercury project is described, and the use of similarly organized teams for future missions is discussed. D.E.R.

N63-17418 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HIGHLY UNDEREXPANDED EXHAUST JETS AGAINST ADJACENT SURFACES
Leonard E. Stitt and William T. Latto, Jr. *In* NASA. Manned Spacecraft Center, Houston, Tex. Manned Orbital Operations Spec. Section [1963] p 107–110 3 refs (See N63-17401 15-32)

Effects of a hot exhaust jet and the resulting temperature and pressure distributions on a cylindrical vehicle and a hard, flat surface are presented. This information could become quite important in planning stage separations, rendezvous trajectory corrections, and lunar takeoff and landing procedures, since the behavior of a flaring exhaust jet in vacuum environments is not known. Presented are: the lunar simulation technique and effectiveness, the landing surface pressure on a jet centerline, the surface pressure on a vehicle, landing surface pressure distributions, the maximum landing surface temperatures, lunar surface temperature distributions, the landing surface heat-transfer coefficient, and the vehicle surface temperatures. D.E.R.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-17282 Space-General Corp., El Monte, Calif.
PREDICTING SPACE MISSION SUCCESS THROUGH TIME-STRESS ANALYSIS
Irving Doshay and Howard Leonard Shuken *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 199–225 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

A technique of reliability prediction is introduced which encompasses the review of vehicle components, their periods of active and passive performance, and the schedule of operational stresses involved in the mission. This methodology is applied to Ablestar space program upper-stage vehicles, where component reliabilities are established from prior experience using ground-test criteria. This is interpreted as the unity stress level, upon which basis the reliability of the vehicle is constructed. It is accomplished by tracing each significant vehicle function and accompanying operational time-stress through the progress of the intended vehicle mission. After the vehicles are fabricated, comparisons are made of the prior published predictions and subsequent tests on the actual vehicles. The results are seen to be very encouraging for further application of this technique. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-16992 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF STEADY-STATE AND SIX-DEGREE-OF-FREEDOM ANALYSES OF PITCH-ROLL RESONANCE CONDITIONS FOR A LONG SLENDER SOUNDING ROCKET
Charles H. Whitlock Washington, NASA, June 1963 28 p 5 refs
(NASA TN D-1816) OTS: $0.75

The amplitude response of a long, slender sounding rocket under pitch-roll resonance conditions has been computed by two methods: a six-degree-of-freedom method of analysis and an approximate solution assuming steady-state flight conditions. Resultant flow-incidence angles and principal vehicle-structural loadings were calculated by both methods and compared throughout a typical flight. From this comparison, it is concluded that the steady-state method of analysis was useful in determining and understanding the loading conditions imposed by pitch-roll resonance for the model and trajectory in question. Author

N63-17027 National Aeronautics and Space Administration, Washington, D.C.
SEVENTH TIROS SATELLITE TO BE LAUNCHED News Release No. 63-132
June 16, 1963 17 p
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

The systems, communications, control, infrared and temperature probes, and launch vehicle, for the seventh TIROS satellite that is scheduled for launch are described. The satellite will obtain cloud cover pictures over hurricane and typhoon breeding areas during the tropical storm season, measure the earth-sun heat-balance radiation relationships, and make electron temperature and density measurements. D.E.R.

N63-17030 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SYSTEM CHECKOUT AND FLIGHT TESTING OF UNMANNED LUNAR AND PLANETARY SPACECRAFT
James F. Mc Gee N.Y., AIAA, 1963 23 p Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., Mar. 18–20, 1963
(NASA Contract NAS7-100)
AIAA: $0.50 members, $1.00 nonmembers

This discussion of system checkout of unmanned lunar and planetary spacecraft is broad in scope and, basically, deals with the overall philosophy and mechanization of testing, rather than the details of experiences on specific spacecraft checkout. Test equipment, facilities, and types of tests are discussed in chronological sequence, beginning with assembly of the spacecraft in Pasadena, and terminating with the launch at the Atlantic Missile Range. Author

N63-17031 Radio Corp. of America. Astro-Electronics Div., Princeton, N.J.
TIROS PRE-FLIGHT TESTING AND POST-LAUNCH EVALUATION
Edwin A. Goldberg N.Y., AIAA, [1963] 21 p Presented at AIAA Space Flight Testing Conf., Cocoa Beach, Fla., Mar. 18–20, 1963
AIAA: $0.50 members, $1.00 nonmembers

Six TIROS satellites have been launched into orbit, and they performed their missions in one of the most successful unmanned space programs to date. The testing and evaluation of each satellite have contributed, in large measure, to their continuing successful performance. The test phases for flight units include acceptance tests, hangar tests, on-stand pre-countdown and countdown tests, and postlaunch evaluation tests. This paper describes the various tests and some of the special test fixtures developed by RCA. As a result of the evaluation of the performance of TIROS I, a "magnetic-dipole" effect was discovered, and this effect was used as the basis for development of an active attitude-control device now used on both the TIROS and the Relay satellites. Author

N63-17052 Hawker Siddeley Aviation Ltd. Astronautics Group (Gt. Brit.)
COMMUNICATION SATELLITES
W. F. Hilton *In* Advisory Group for Aeronautical Research and Development, Paris (France) Proc. of the Eleventh AGARD Gen. Assembly, 27 and 28 July 1961 [1961] p 69–75 3 refs
(See N63-17048 15-01)

The areas that pose technical problems for telecommunication satellites are discussed. Problems discussed are to determine: whether to use an active radio repeater or a passive reflector; the type of attitude stabilization; area of earth requiring coverage; the minimum number, and the best orbit and altitude of satellites needed for area covered; whether satellites should keep station or be distributed randomly in orbit; maximum number of ground stations per satellite; and the radio modulation technique to be employed. D.E.R.

N63-17167 National Aeronautics and Space Administration. Manned Spacecraft Center, Cape Canaveral, Fla.
SOME ABORT TECHNIQUES AND PROCEDURES FOR MANNED SPACECRAFT
John M. Eggleston Repr. from Aerospace Eng., v. 21, no. 11, Nov. 1962 p 17–26 12 refs

The present state of knowledge on the procedures and effectiveness of aborts from manned orbital and lunar missions is reviewed. Current atmospheric abort procedures used with the Mercury spacecraft employ a set of tower-mounted solid rockets which pull the spacecraft off the launch vehicle; contemplated improvements will eliminate the possibility of collision of the spacecraft and the separation rocket. Extra-atmospheric suborbital abort procedures include corrective thrust and attitude controls to reduce the entry deceleration forces and to control the range of the vehicle in relation to recovery sites. Superorbital abort procedures are less ironclad because, once superorbital velocities have been reached, the centrifugal acceleration due to velocity will exceed the acceleration due to gravity and the vehicle will move away from the earth even though the motor is shut down. The alternative procedures in this case are: (1) if sufficient fuel is available, a velocity change can be effected to deflect the vehicle's trajectory so that it intersects the atmosphere before apogee; or (2) if sufficient fuel is not available for a velocity change, the vehicle must continue to apogee using the available fuel to change the orbit so that the perigee lies within the atmosphere. A "way station" concept of stored programs is being considered for abort from translunar trajectories. At the moon, actual onboard computations of the optimum thrust maneuver will be necessary, although the lack of a lunar atmosphere should greatly simplify the choices. M.P.G.

N63-17203 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPERATIONS WITH AN EXPERIMENTAL SATELLITE
D. G. Mazur May 1, 1963 44 p
(NASA TM X-50104; NASA X-620-63-86) OTS: $4.60 ph, $1.52 mf

The operational aspects of an engineering type experimental satellite are considered in light of the techniques and procedures employed and experience gained in the successful in-orbit operation of the RELAY communication satellite. Requirements for satellite command and real-time telemetry data reduction and evaluation are emphasized and the actual system employed for RELAY is described. Real-time checkout and evaluation of the satellite's wideband communication subsystem is similarly discussed. The manner in which these capabilities were employed is illustrated with specific examples given. Need for a central operational control point is considered with specific emphasis on communication satellites. The operations center for RELAY is described and its functions detailed. The operational support communications, such as teletype, telephone and video monitor links, required to perform effective control of the satellite through the test and control station and coordination of the complex of ground stations is illustrated. Specific capabilities and potentialities of this center are detailed. Author

N63-17211 Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOGUE OF SATELLITE OBSERVATIONS NO. C-32

Beatrice Miller Jan. 29, 1963 82 p
(NASA Grant NsG-87-60)
(SAO Special Report-115) OTS: $8.10 ph, $2.66 mf

The following satellites were observed during the period, January 1 through June 30, 1962: Satellite 1960 Iota I (Echo I), Satellite 1960 Iota 2 (Echo I rocket), and Satellite 1960 Iota 2 (Echo I rocket). The data given list the month and day of the observations; the time (U.T.) is given in hours, minutes, and seconds; right ascension is in hours, minutes, and seconds; azimuth is measured from north through east; and the range is in kilometers. N.E.A.

N63-17248 Electro-Optical Systems, Inc., Pasadena, Calif.
RUSSIAN NEWS BRIEFS: "MARS-I" IN FLIGHT
Joseph L. Zygielbaum May 24, 1963 3 p Transl. from Pravda (Moscow), May 17, 1963

The "in-flight" operations are reported of the Mars I automatic satellite systems, made at a distance of 106,000,000 kilometers from the earth on March 21, 1963. Radio communications with the spacecraft have yielded data on the physical properties of space regions, the properties of the earth's radiation belts, cosmic radiation, the interplanetary and solar plasma, solar winds, space magnetism, and the distribution of meteoric matter. An analysis of the operational characteristics of the radio waves themselves has shown that their energy levels are sufficient to secure reliable communications up to a distance of 300,000,000 kilometers. D.E.R.

N63-17292 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
TRANSIT RELIABILITY
Richard W. Cole *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 333–337 (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The TRANSIT navigation system as presently conceived and planned consists of four satellites orbiting at 500 to 600 nautical miles in a polar orbit. Each satellite contains two high-frequency transmitters whose frequency is obtained through multiplication from an ultrastable oscillator for Doppler data, plus a memory from which the satellites present ephemeris data are continuously transmitted in digital form using pairs of doublets with phase modulation on one of the high-frequency transmitters. The Applied Physics Laboratory is making every effort to conduct a program which is balanced between research, development, and engineering, whose program goal in reliability is to make a long operational lifetime in orbit an inherent "designed in" characteristic of the TRANSIT tactical satellites. Author

N63-17392 National Aeronautics and Space Administration, Washington, D.C.
SPACE EXPLORATION 1962
James E. Webb Repr. from Aerospace, Jan. 1962 4 p

A discussion is presented on the over all spaceflight program and progress in the United States since January 1958. Views are given of satellite exploration, manned spaceflight, and missions by the experimental X-15 aircraft. Included in the discussion are such programs as: the Explorer project, the orbiting observatories, the Tiros program, and the Pioneer, Telstar, Ranger, Syncom, Gemini, and Apollo projects. Also discussed are launch vehicles, such as the Delta, Atlas, Atlas-Agena, and Saturn systems. C.L.W.

N63-17401 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MANNED ORBITAL OPERATIONS Special Section
N.Y., American Inst. of Aeronautics and Astronautics [1963] Repr. from Astronautics and Aerospace Eng., Feb. 1963 p 22-117 45 refs

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17. HIGHLY UNDEREXPANDED EXHAUST JETS AGAINST ADJACENT SURFACES L. E. Stitt and W. T. Latto, Jr. (NASA. Lewis Res. Center) p 107-110 3 refs (See N63-17418 15-30)
18. WIND TUNNEL STUDIES OF BOOSTER BASE HEATING M. A. Beheim and L. J. Obery p 111–117 17 refs (See N62-13426 10-31)

N63-17402 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE PROGRESS, 1962
Robert R. Gilruth *In its* Manned Orbital Operations Spec. Section [1963] p22-32 (See N63-17401 15-32)

Progress during the last year in the three manned spaceflight projects of the U.S. are summarized, with emphasis placed on the cooperation between government-civilian-military-industry teams and the joint effort's achievements in the Project Mercury flights. The teamwork and coordination of individual efforts required by the Gemini and Apollo projects

are discussed, and the reliability and quality control requirements, from design to component testing, essential to successful flight are enumerated. D.E.R.

N63-17403 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FROM MERCURY TO MARS
Maxine A. Faget and Paul E. Purser *In its* Manned Orbital Operations Spec. Section [1963] p 24-28 (See N63-17401 15-32

The more advanced space missions planned by NASA—such as the orbiting space station, a lunar base, and interplanetary manned missions—are discussed to discover how they can provide orderly progress toward the goal of solar system exploration. To obtain such progress, planners of future programs should: (1) plan pointed, specific, and orderly programs that provide useful short-term knowledge and lead logically to the next longer term step; (2) insure that estimates of near-future progress are not lowered; (3) be prepared to make less progress than estimated in early stages of the program; (4) be prepared to encounter otherwise unseen advances which will speed progress in the later stages of a program; and (5) plan the approach to new programs so that, with firm goals not subject to excessive change, the plans are enough to be modified by breakthroughs and advances in the state of the art. It is concluded that the cumulative technology of the Mercury, Gemini, and Apollo projects and the space-station operations will establish a sound base for manned interplanetary flight. D.E.R.

N63-17404 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PROJECT MERCURY EXPERIENCES
William M. Bland, Jr., and Charles A. Berry *In its* Manned Orbital Operations Spec. Section [1963] p 29-34 (See N63-17401 15-32)

The manned spaceflights of Project Mercury are studied in retrospect and are found to have accomplished their primary objective, in achieving manned orbital flight, and to have: (1) confirmed the basic Mercury concepts of using simple, reliable systems, and existing launch vehicles, and a logical and progressive test program; (2) proved the Mercury design, production, inspection, qualification, and checkout systems; (3) shown the value of training the flight and ground-network crews to overcome deviations from the normal pattern; (4) proved the possibility of analyzing, documenting, and distributing the data from a manned space mission within three weeks of the mission. The management structure of the project is also discussed, and its capabilities of program direction are pointed out. D.E.R.

N63-17405 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PROJECT GEMINI DESIGN PHILOSOPHY
James A. Chamberlin and Andre J. Meyer, Jr. *In its* Manned Orbital Operations Spec. Section [1963] p 35-39 2 refs (See N63-17401 15-32)

The design philosophy of the Gemini project is examined and the primary objectives of the project are presented to: (1) provide a logical follow-up to the Mercury project with a minimum of expense and time; (2) subject two men and their supporting equipment to long-duration flights in space; (3) rendezvous and dock with another orbiting vehicle; (4) maneuver in space to a new propulsion system after docking; (5) find the effect of the space environment on men outside the spacecraft while it is in orbit; and (6) perfect methods for returning and landing the spacecraft on a small prescribed land site. It is believed that the flight of the Gemini craft will make orbital flight commonplace. D.E.R.

N63-17409 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE STATIONS – LOGISTICS SYSTEMS AND ASSOCIATED OPERATIONS REQUIREMENTS
Charles W. Mathews *In its* Manned Orbital Operations Spec. Section [1963] p 60-63 (See N63-19401 15-32)

The logistics spacecraft concept to supply orbital space stations is developed, and the following points are made: (1) logistics spacecraft will be required to support the space-station program in long duration missions; (2) the economics of such support will require larger transport capabilities than those now existing in manned spacecraft; (3) launch and rendezvous techniques for space-station support will approach those of current projects; and (4) the blunt-body configuration of present manned spacecraft affords sufficient operational flexibility to use it as a logistics spacecraft, but winged configurations may be developed later. D.E.R.

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-17014 RAND Corp., Santa Monica, Calif.
NEW EVIDENCE CONCERNING THE ORIGIN OF FATIGUE CRACKS AS A SURFACE PHENOMENON
F. R. Shanley May 1962 11 p 10 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3164-PR; AD-276365)

Recent results from studies of surface effects, particularly at ultrahigh vacuum, are reviewed with respect to the origin and growth of fatigue cracks. These results appear to offer new evidence that tends to substantiate an earlier theory of fatigue proposed by the author. Author

N63-17021 Aeronautical Systems Div. Metals and Ceramics Lab., Wright-Patterson AFB, Ohio
FATIGUE OF COPPER-ZINC ALLOYS AT 100°K [Final Report, Jan.–Oct. 1962]
J. C. Grosskreutz (Midwest Research Inst.) and J. A. Roberson Apr. 1963 27 p 15 refs
(ASD-TDR-63-252)

Fatigue tests were conducted to determine the S-N diagrams for a series of copper-zinc alloys at 100° K. An attempt was made to relate the endurance-limit behavior to both stacking-fault energy and yield strength, but no simple relationship was found. It is suggested that high stacking-fault energy increases the cyclic work-hardening rate by increasing the probability of dislocation intersection and jog formation. The increase in work-hardening rate is reflected in a decrease in plastic-strain amplitude, and a subsequent increase in fatigue life. These arguments are bounded on one side by considerations of the yield strength of the alloys, and on the other side by consideration of the dominant mechanisms operative in short- and long-life fatigue. Author

N63-17061 Syracuse U. Research Inst., N.Y.
DEFORMATIONS AND STABILITY OF SPHERICAL SHELLS UNDER ACTION OF ECCENTRIC CONCENTRATED LOADS AND UNIFORM PRESSURE Technical Report
R. M. Evan-Iwanowski and T. C. Loo Mar. 11, 1963 44 p 21 refs
(Grant DA-31-124-61-G24)
(Rept. 834-363T6; SURI-TR-834/No. 6; AROD-2465-8)

Deformations and collapse of a series of spherical shells with a wide range of geometry parameter λ ($\lambda^4 = a^4|12(1-\nu)^2/(Rt)^2|$) and edge supports subjected to the action of concentrated eccentric loads, uniform loads, and combination of uniform and concentrated loads have been investigated. The prebuckling and post-buckling histories of the deflections, stress distributions, and critical curves (showing the relationship between critical loadings and geometry parameter λ) have been determined. New phenomena are observed for simply supported and free-edge conditions under concentrated loading. There exist three ranges of position of eccentric load between the apex of a shell and its edge along the meridional line within which a distinct behavior of a shell is manifested. Author

N63-17177 Brown U. Div. of Engineering, Providence, R.I.
SOME REMARKS ON FLOW AND FRACTURE
D. C. Drucker May 1963 27 p 21 refs
(Sponsored by ARPA)
(ARPA-E6)

The relation between physical behavior and its mathematical representation is examined for real materials and for their time-dependent and time-independent idealizations. Emphasis is placed on the need to incorporate the essential physical concepts into theory at the very beginning, and on the fact that physical reality is so complex that it must be idealized strongly if it is to be formalized mathematically. The considerable progress which has been made in understanding the problems of flow is reviewed. The far slower progress made in the attack on problems of fracture is discussed for both ductile and brittle fracture. Some of the simpler carryovers between the inhomogeneous atomistic or dislocation point of view and the locally homogeneous macroscopic or phenomenological approach are exhibited. Author

N63-17181 Minnesota U., Minneapolis
DAMPING OF MATERIALS UNDER BIAXIAL STRESS [Summary Report, Jan. 1, 1961-Aug. 1, 1962]
P. J. Torvik, S. H. Chi, and B. J. Lazan Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, May 1963 52 p 13 refs
(Contract AF 33(657)-7453)
(ASD-TDR-62-1030)

A new theory of combined stress damping is developed and evaluated on the basis of experimental results for several materials. It is concluded that the new theory should be limited in application to materials whose dominant damping mechanism is known to be plastic deformation. It appears that a separate theory of combined stress damping may be required for each mechanism of damping. Author

N63-17183 California Inst. of Tech., Pasadena
SOME RECENT CONTRIBUTIONS TO PANEL FLUTTER RESEARCH
Y. C. Fung N.Y., Inst. of the Aerospace Sciences [1963] 32 p 39 refs Presented at the IAS 31st Annual Meeting, New York, Jan. 21-23, 1963
(IAS Paper-63-26) IAS: $0.50 members, $1.00 nonmembers

This paper summarizes some recent contributions to panel flutter research. A brief description of experimental results concerning flat plates and cylindrical shells is given. The experimental and theoretical investigations taken together provide a fairly clear picture with regard to proper assumptions for an accurate analysis. Author

N63-17198 Aeronautical Research Council (Gt. Brit.)
A PHOTOGRAPHIC STUDY OF THE ORIGIN AND DEVELOPMENT OF FATIGUE FRACTURES IN AIRCRAFT STRUCTURES
Jennifer Longson London, HMSO, 1962 66 p 6 refs
(Previously issued as RAE-R-STRUCT-267; ARC-23241)
Available from HMSO: 17s 6d

Experience over a period of years of the appearance of fatigue fracture surfaces of aircraft structural components is illustrated by photographs. All specimens were tested under fluctuating tensile loads. Information on stress level and material is given. The photographs are systematically arranged under the broad headings: effect of loading conditions on appearance, influence of detail design upon origin of failure, effects attributable to differences in structural forms. Author

N63-17199 National Bureau of Standards, Washington, D.C.
THE IMPORTANCE OF ENVIRONMENT IN FATIGUE FAILURE OF METALS
J. A. Bennett, W. L. Holshouser, and H. P. Utech N. Y., Pergamon Press Repr. from "Fatigue of Aircraft Structures", 1963 p 1-18 33 refs
(NASA Order R-14)
(NASA CR-50326)

A review of experiments reported during the past 30 years indicates that the fatigue strengths of many metals are reduced by the surface reactions occurring even in a normal indoor atmosphere. For most iron-, aluminum-, or copper-base alloys the reduction is 5 to 10 percent as compared with the fatigue strength in vacuum or inert atmosphere. Recent investigations have shown that these deleterious effects can often be eliminated by the application of certain polar organic liquids which form protective films on the metal. The presence of these compounds on the surface of fatigue specimens may increase both the number of cycles to initiate a crack and the number required to propagate the crack to fracture. Under certain conditions, the surface reactions occurring during fatigue result in the evolution of gas; this can be made visible by the application of a transparent pressure-sensitive tape to the specimen before testing. Bubbles appearing under the tape indicate fatigue damage prior to the development of a detectable crack. Author

N63-17221 Battelle Memorial Inst., Columbus, Ohio
EXPLORATORY STUDIES OF MECHANICAL CYCLING FATIGUE BEHAVIOR OF MATERIALS FOR THE SUPERSONIC TRANSPORT Third Quarterly Progress Report [Jan. 1-Apr. 15, 1963]
D. N. Gideon, C. W. Marschall, F. C. Holden, and W. S. Hyler Apr. 15, 1963 25 p 5 refs
(NASA Contract NASr-100(01))
(NASA CR-50365) OTS: $2.60 ph, $0.95 mf

Tensile stress-strain data have been obtained at −100° F and at 550° F on both the AM 350 and the Ti-8Al-1Mo-1V alloys. These supplement similar data obtained earlier at room temperature. The generation of fatigue data for both alloys has continued. Center-notched specimens of AM 350 steel were made in order to investigate residual-strength and crack-propagation behavior with respect to several variables, including temperature, alternating stress, cycling rate, stress-temperature exposure, etc. Replicas of AM 350 fatigue-fracture surfaces

produced at three different stress levels were studied with the electron microscope. Eleven center-cracked AM 350 sheet specimens have been tested in tension at room temperature to measure residual strength and fracture toughness. The relatively high ductility of the AM 350 precluded determination of K_c values; however, K_{Ic} values were calculated, based upon the original crack length and the stress at which the load-elongation curve deviated from linearity. Author

N63-17239 Battelle Memorial Inst., Columbus, Ohio
INVESTIGATION OF NOZZLE-FAILURE MECHANISMS AND OF PARAMETERS AFFECTING NOZZLE-MATERIAL SUITABILITY IN SOLID-PROPELLANT ROCKETS Third Quarterly Report [Sept.-Nov. 1962]
J. F. Lynch, I. Grinberg, D. J. Bowers, and W. H. Duckworth Nov. 30, 1962 36 p refs
(Contract AF 33(657)-8212)

Temperature levels attained by various nozzle inserts in firing trials of a solid-propellant motor were calculated; the thermal histories were used to verify and assess critical parameters for nozzle materials in respect to refractory limitation and thermal-stress resistance. Corrosion-erosion phenomena in various materials also were evaluated in firing trials employing an O_2-H_2 motor. Author

N63-17246 Japan. Ministry of Transportation. Transportation Technical Research Inst., Tokyo
ON BRITTLE CRACK PROPAGATION AND ARREST—THEORETICAL AND EXPERIMENTAL ANALYSES OF ESSO TEST WITH TEMPERATURE GRADIENT
Yoshio Akita and Kazuo Ikeda Dec. 1962 27 p 23 refs Presented at the Meeting of International Inst. of Welding, Helsinki, 1963
(TTRI-56)

The mechanism of propagation and arrest of brittle crack, governed by the plastic surface energy, the temperature, the crack length, and the applied stress, was investigated from the viewpoint of crack speed. The ESSO test with a temperature gradient was conducted and analyzed theoretically. A crack propagating in a field of gradient temperature reduces its speed gradually with increasing crack length, and then is arrested abruptly when the speed decreases to the critical crack speed. The effect of shear lip on the plastic surface energy was found by using a specimen with a hardened surface. The stress-arresting temperature curve for a given temperature distribution was estimated approximately from the crack-speed data under a stress level. Author

N63-17272 General Electric Co. Light Military Electronics Dept., Utica, N.Y.
THREE LESSONS FROM THE RELIABILITY VERIFICATION PROGRAM
David B. Christian *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 61–67 4 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The lessons learned from the reliability testing of the MOD III A/B airborne guidance equipment are discussed and the test program explained. The tests assumed that: the repeated vibration cycling would not reduce equipment life or performance; the laboratory simulation of the vibration environment was adequate; and the sample used is representative of the population of the guidance systems. The testing was conducted in order to: (1) estimate the reliability of the MOD III A/B equipment during countdown and flight, (2) derive information to further improve the system's reliability, and (3) verify the feasibility of reliability experiments. The lessons learned are: (1) this type of reliability testing can and should be a valid means for demonstrating the reliability of a system; (2) there are relationships between time, cycling, and vibration; and (3) the time required to perform such a program may limit its value. D.E.R.

N63-17273 Sperry Utah Co., Salt Lake City, Utah
THE SUCCESSFUL APPLICATION OF A REPEATED TEST-TO-FAILURE PROGRAM ON SERGEANT MISSILE ASSEMBLIES. PART I. THE DESIGN, APPLICATION, AND RESULTS OF THE COMBINED OPERATING TEMPERATURE VIBRATION TEST FOR MISSILE ASSEMBLIES RELIABILITY. PART II. STATISTICAL TECHNIQUES APPLIED TO THE SERGEANT REPEATED TEST-TO-FAILURE PROGRAM. PART III. CONCLUSIONS AND RECOMMENDATIONS
Richard H. Brashear, Jr., and Larry Blundell *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 69–98 1 ref (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

The tests discussed are the results of the practical application of a test-to-failure program based upon Latin square and regression analysis models. This test program was designed and put into effect to assess the capabilities of the Engineering Model to meet its expected environment, including allowance for variations in environmental extremes. The program included reliability tests as well as type-approval environmental tests. Author

N63-17274 General Dynamics/Pomona, Calif.
RESULTS OF A TEST-TO-FAILURE PROGRAM ON ELECTRONIC PARTS
Louis M. St. Martin *In* Defense Dept. Off. of the Director of Def. Res. and Eng., Wash., D.C. [Papers Presented at the] Seventh Mil.-Ind. Missile and Space Reliability Symp., NAS, North Island, Calif., 18–21 June 1962 [1962] p 111–120 10 refs (See N63-17266 15-01) OTS: $23.50 ph, $14.33 mf

Forty-two tests on twenty-three parts and seven assemblies have been completed; some items were tested in more than a single environment. The environments were high and low temperature, vibration, shock, and acoustic noise. Twenty-six of the tests disclosed adequate safety margins. The other sixteen tests resulted in corrective action ranging from reducing the stress on the item to replacing the item with one of adequate strength. Author

N63-17303 Bureau of Mines. Explosives Research Lab., Pittsburgh, Pa.
HYPERVELOCITY IMPACT PHENOMENA Quarterly Report, Mar. 1, 1963–May 31, 1963
Richard W. Watson, Karl R. Becker, J. Edmund Hay, and Frank C. Gibson June 6, 1963 42 p 8 refs Presented at the Sixth Hypervelocity Impact Symp., Cleveland, Ohio, Apr. 30–May 2, 1963

The more important aspects of the thin plate perforation process have been investigated over the range from 2 to 5 km/sec. Particular emphasis was placed on studying the spatial, mass, and velocity distribution of rear surface ejecta as the impact velocity, projectile scale size, and target thickness varied. A number of simple relationships have been established among these variables. For the case of a non-deforming projectile, it is shown that residual projectile velocity and target impulse can be predicted on the basis of a simple mathematical model. In situations where the projectile is seriously deformed, the observations relating to the

behavior of the target ejecta system indicate the applicability of a simple-shock-spallation model. Evidence supporting the proposed spall model is given. N.E.A.

N63-17472 Illinois U., Urbana
APPLICATION OF FRACTURE MECHANICS TO ORTHOTROPIC PLATES
Edward M. Wu June 1963 57 p 12 refs
(Contract Nonr-2947(02)(x))
(T&AM-248)

The Griffith–Irwin (or linear-elastic) fracture concept was used to investigate the feasibility of the application of fracture mechanics to orthotropic plates. The problem of an infinite plate containing a single crack, orientated in the direction of one of the planes of elastic symmetry of the plate subjected to arbitrary plane loading, was examined. Two analytical crack-tip stress analyses for this case are presented, and unlike the isotropic case, the stress distributions are observed to be dependent on the material constants. However, as in the isotropic case, the crack-tip stress singularity was observed to be $r^{-1/2}$, and stress-intensity factors $k_1 = \sigma\sqrt{a}$ and $k_2 = \tau\sqrt{a}$ for loading symmetric and skew-symmetrical to the crack, respectively, could be used. Further, the existence of a functional relation between k_1 and k_2 was proposed. Results of the experimental investigation using balsa wood plates indicate that the critical stress intensity factors k_{1c} and k_{2c} are constants for tension and pure shear. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-16986 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBIT-LAUNCHED NUCLEAR VEHICLE DESIGN AND PERFORMANCE EVALUATION PROCEDURE FOR ESCAPE AND PLANETARY MISSIONS
Ronald J. Harris and Robert E. Austin Washington, NASA, June 1963 74 p 6 refs
(NASA TN D-1570) OTS: $2.00

A comprehensive procedure is described, and reference data presented, by which the effect of certain design parameters upon the basic performance of orbit-launched nuclear vehicles can be readily determined for escape and planetary missions. The performance parameters investigated are payload ratio, propellant ratio, characteristic velocity requirement, burning time, injection altitude, central angle and flight-path angle. The effects of initial thrust-to-weight ratio, initial altitude, specific impulse, specific weight factors and hyperbolic excess velocity are considered. The range of specific impulse assumed is restricted to that considered practical for nuclear-heat-exchanger propulsion systems. Numerical examples are included which illustrate the methodology and indicate the degree of accuracy that can be expected of the estimation procedure. The results of the numerical examples are compared with exact computer solutions, and are shown to be well within the accuracy usually required in preliminary design studies. Author

N63-17182 Case Inst. of Tech., Cleveland, Ohio
A REPORT ON A STRUCTURAL SYNTHESIS CAPABILITY FOR INTEGRALLY STIFFENED WAFFLE PLATES
Lucien A. Schmit, Jr., Thomas P. Kicher, and William M. Morrow [1963] 42 p 20 refs Presented at the AIAA Launch and Space Vehicle Shell Structures Conf., Palm Springs, Calif., Apr. 1–3, 1963
(NASA Grant NsG-110-61)
(Paper 2894-63)
(AIAA Paper 2894-63) AIAA: $0.50 members, $1.00 nonmembers

An automated, minimum weight, optimum-design capability for rectangular, simply supported, waffle plates subjected to a multiplicity of inplane load conditions is presented. The synthesis involves six design parameters (total depth, back-up sheet thickness, stiffener thickness in the x and y directions, and stiffener spacing in the x and y directions). The behavior constraints are provided primarily by elastic stability failure modes. Numerical results for several symmetrical as well as unsymmetrical waffle-plate optimum designs are presented. The results of the waffle-plate synthesis study support the contention that structural synthesis capabilities for complex structural configurations of current and future importance are feasible. Author

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